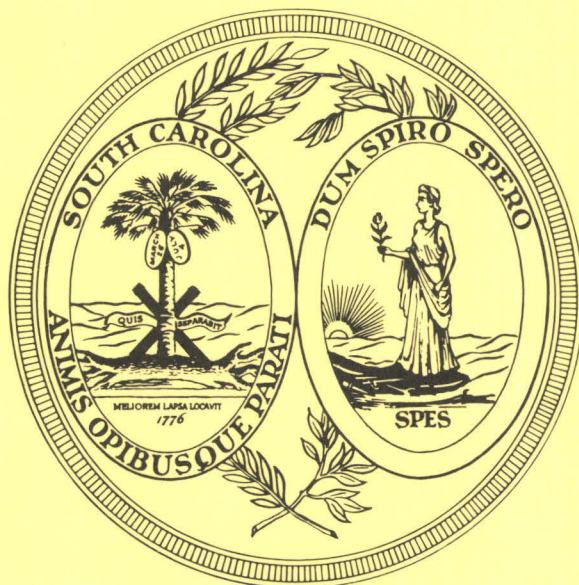


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CLEMSON UNIVERSITY



ANNUAL REPORT 1990-1991

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CLEMSON UNIVERSITY

PRESIDENT

It is tempting to think of a university only as a place, as a location defined by classrooms, laboratories, landmarks and quiet corners. Students are said to "attend" a university; faculty are said to teach and conduct research "there."

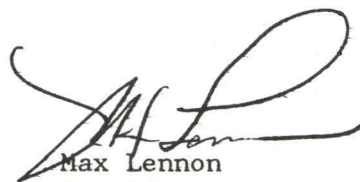
That is not an adequate description of Clemson University, its students or its faculty.

While we are proud of our physical plant and of our beautiful natural setting, Clemson University is much more than a place. Clemson is an active, vital, dynamic participant in the business of living and in the goal of making life better. In short, Clemson University is a contributing member of society.

From the local level to the global scale, Clemson practices good citizenship: We use our resources, our ideas and our vision to benefit those with whom we share this planet.

Our activities and accomplishments during 1990-91 are strong evidence of this. On the pages that follow are examples of Clemson's citizenship within our local community, our state, our region, our nation and, ultimately, our world.

As these examples indicate, Clemson University is making a significant impact for good at every level of society.



Max Lennon
President

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1990-91 ADMINISTRATIVE OFFICERS

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| Benton H. Box, D.F. | Dean, College of Forest and Recreation Resources |
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| Opal Hipps, Ph.D. | Dean, College of Nursing |
| Bobby G. Wixson, Ph.D. | Dean, College of Sciences |

Admissions and Registration

| | |
|------------------------------|---|
| Bobby J. Skelton, Ph.D. | Associate Vice President for Student Affairs and Dean of Admissions and Registration |
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1990-91 BOARD OF TRUSTEES

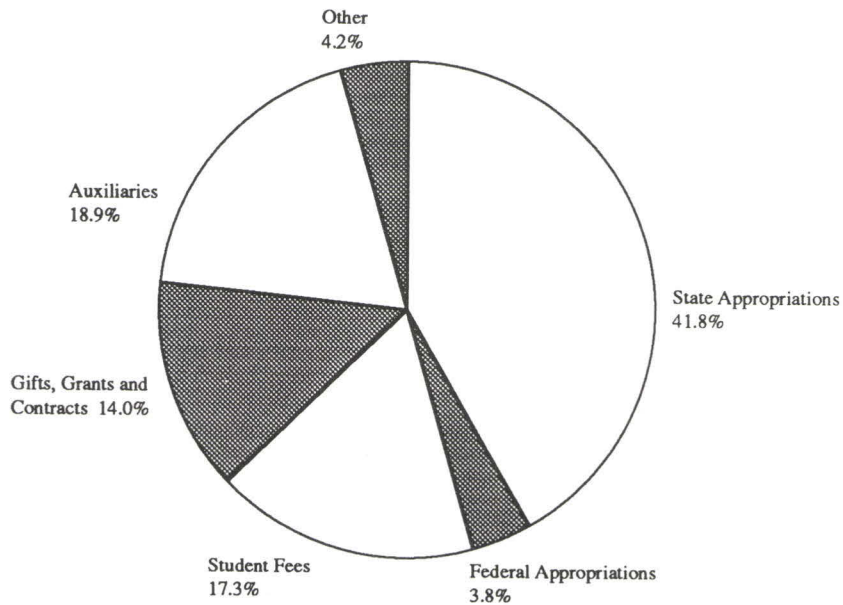
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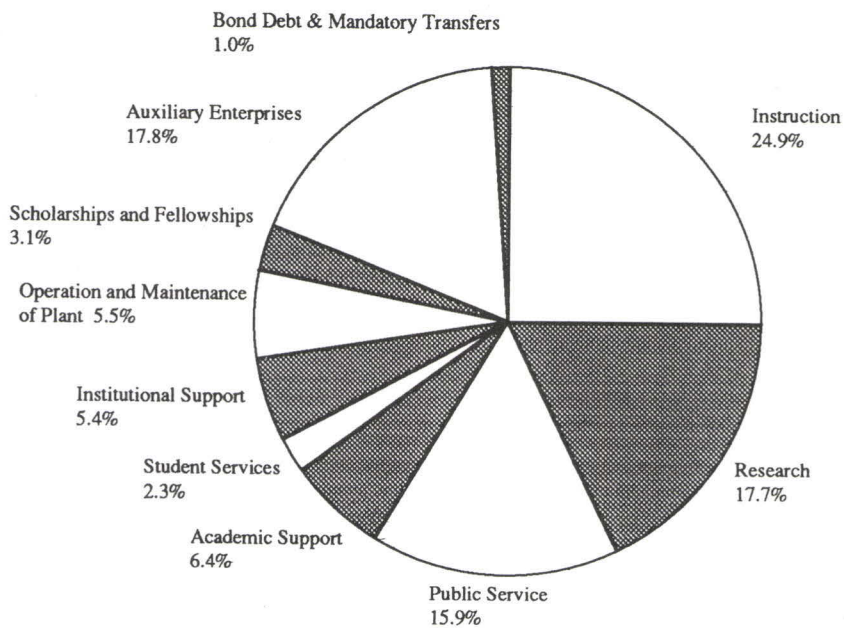
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| Paul Quattlebaum, Jr. | Charleston |
| James C. Self | Greenwood |
| D. Leslie Tindal | Pinewood |
| James M. Waddell, Jr. | Beaufort |

CURRENT FUND REVENUES AND EXPENDITURES FOR THE YEAR ENDED JUNE 30, 1991

Current Fund Revenues



Current Fund Expenditures



COLLEGE OF AGRICULTURAL SCIENCES

The report of 1990-91 activities for the College of Agricultural Sciences' academic, research and Extension programs is included under the Division of Agricultural and Natural Resources on page 58.

COLLEGE OF ARCHITECTURE

Viewing the changes in the College of Architecture from a five-year perspective reveals a half-decade of remarkable growth and successful response to challenge. In fact, since the strength of the college has been its tradition, the pace of change has been incredible. Perhaps the single greatest achievement over the past five years has been the successful determination of what must not change and what must change in the College of Architecture. This can only be accomplished by thoughtful strategic planning and good communication. All constituencies of the college have been a part of this effort, but it is the faculty who have brought about a genuine cultural change.

As remarkable as the past five years have been, they simply establish the base for the other half of the decade. In fact, the "easy" part has been accomplished; the "hard" part remains. The next five years will require more thoughtful, substantive energy and vision. Since it is easier to continue a cultural change with resources than without, the next five years will challenge the ability of the college to think and act creatively in a climate of reduced state support.

The college is well positioned for the next stage in its evaluation because of its base in creativity and its understanding of change and tradition. Another level of vision and energy will be required to reach the promise of a College of Architecture in the state of South Carolina that is seen as America's best.

Highlights from the 1990-91 year include:

- There are nine national professional boards which govern the disciplines in the College of Architecture. With elections and appointments in 1990-91, College of Architecture faculty were represented on all of these national boards. Established as a priority in the strategic planning process, this accomplishment provides the college with national visibility and vision and insures that our students are current and prepared for a complex future.
- Teaching always has been the focus of the faculty in the college. Recently the quality of teaching has received national recognition. Professors Don Collins and Harry Harritos were honored in the AIA's National Education Honors for their innovative teaching in the design studio for their project "Mask." Faculty in the college have been recognized in three of the four years of the AIA's National Education Honors.
- The Department of Planning Studies has been awarded a \$241,880 grant from the Department of Housing and Urban Development for its continuing program to provide a work-study program for graduate students while they pursue a degree in City and Regional Planning.
- The college's new programs continued to show growth in quality and quantity, attracting new students with excellent qualifications and strengthening the college's position of attracting the University's best and brightest students.

Special Programs

The Clemson Architectural Foundation Lecture Series, supported by donations

to the Clemson Architectural Foundation, sponsored the following speakers for the academic year 1990-91:

| | | |
|--------------------|--------------------------|--|
| September 21 | Peter Walker, FASLA | "Landscape as Art" |
| October 15 | Raymond J. Kaskey | "Recent Work" |
| October 29 | David Gosling | "Urban Design Strategies: Successes and Failures in the United Kingdom" |
| November 16 | Peter Eisenman | "Recent Work" Metromont Materials Lectureship |
| November 26 | Samuel Mockbee, FAIA .. | "Recent Work" |
| March 8 | Anthony Ames | "The Song Remains the Same - Recent and Not so Recent Work" Richtex Lectureship |
| March 25 | Rob Miller | "Red Lining the Wexner" |
| March 29 | Lebbeus Woods | "Terra Nova" |
| April 22 | Thom Mayne | "Recent Work" |

The Rudolph E. Lee Gallery is the University's art gallery, and the following exhibitions were shown last year:

| | |
|--------------------------|---|
| Aug. 27 - Sept. 14 | Faculty Show |
| Sept. 24 - Oct. 17 | Transforming the American Garden |
| Oct. 29 - Nov. 15 | Gardens Real and Imagined |
| Dec. 3 - 14 | MFA Thesis Exhibition |
| Jan. 21 - Feb. 24 | Folk: The Art of Benny Andrews |
| March 11 - 29 | 5th Clemson National Print and Drawing Show |
| April 1 - 19 | Thesis Exhibitions |

Department of Architectural Studies

By all accounts this has been a very successful year for the department. Our faculty and students have received recognition for their efforts. We have established a variety of new initiatives and have renewed our traditional emphasis on fundamentals. We have adopted a view of the department that sets out nine areas of interest. Following is a brief description of activities in each of these areas:

Pre-Enrollment

- Professor Kishimoto's two-week Architecture Camp for high school students completed its third year of operation. This is an excellent program for young people who are in their sophomore or junior year and think that they might be interested in our field.
- Professor Sammons represented us this year at the Governor's School for the Arts at Furman, and Professor Tai was our first representative at the Governor's School for the Humanities at the College of Charleston.

Foundation

- This series of four courses at the freshmen level introduces students in design, landscape, art and construction to the principles and elements of design in addition to introducing them to the purpose of a university education in establishing an open-minded approach to learning.
- Professor Robert Hunter (Visual Arts) has prepared a two-volume retrospective of the foundation program. This will provide an in-depth look at our approach during the past two decades to the teaching and learning of introductory level design.

- We have given this program a permanent home in a small studio that accommodates 25 students in five sections that meet at different times of the day.
- To better assimilate those students who wish to change their major to design, we have established a summer program that is a precise mirror of the normal first year but also allows for some experimentation with course work.

Undergraduate Programs

- We have continued our vertical studio efforts during the spring semester, this year adopting the theme "Ethnic Identity in the Urban Environment." An interdisciplinary symposium including faculty members from other parts of campus and the noted anthropologist/architect, Amos Rappaport, provided a stimulating kickoff to the vertical studio efforts.
- At the second year level a new initiative beginning with the "elements" project carried through ideas related to "house" and presented by Professors Collins and Harritos to the AIA Committee on Education. This committee has awarded these professors with their Honor Award for 1990-91.
- At the fourth year level the faculty had initiated the New Directions Studio which has afforded an opportunity for those seniors who will find their careers in fields other than architecture to study various alternatives and prepare in-depth reports and projects in new directions.
- For the first time a senior exit project was fashioned, focusing on ideas related to the "institution" in society.
- Professor Bob Hogan has been appointed as undergraduate director. This key administrative move has enabled him to bring to the faculty the depth of his understanding of undergraduate education as a more liberal education that projects both the discipline and attitude for further professional study. The third year faculty hosted children from grammar schools bringing them to our studios for a day and providing them with exercises in design.
- A report of undergraduate studies would not be complete without citing the strong efforts of students governing the American Institute of Architects/Student Chapter (AIA/S). Rebecca Jarvis, Susan Creech and Kim Murray were instrumental in tripling the membership of the organization which provided programs and activities throughout the school year. The most notable of these programs was our first annual Graphics Workshop which brought nationally recognized architectural delineators to campus for a full day workshop. Professor Harritos helped to organize this as well as served as AIA/S faculty advisor.

Charleston

- The Charleston Studio continues to provide a forum for our discussion of expanded expectations and consistently higher standards. The intensity and discipline of the small studio in the magnificent urban setting cannot be matched in the bigger arena of the university.
- Professor Gooden, in his first year of teaching, has done an outstanding job and will be going next year to Africa on a grant from Columbia University to study the religious architecture of Western Africa.
- Professor Ray Huff was selected by the students of Tau Sigma Delta to receive that organization's Silver Medal honoring the design work of an architect within the region.
- The Charleston program continued to provide an opportunity for a bi-monthly casual gathering of architects and students at the Tuesday night lecture/film series.

Post Baccalaureate

Although this program is in its sixteenth year of operation we have felt that we have never begun to tap the potential of bringing in bright and energetic young people from other fields. Our problem within the framework of the University's Graduate School involves a question of status; the Graduate School does not recognize the post baccalaureate student as having either undergraduate or graduate status. Professor Hutton has been working closely with the Graduate School to establish a proper and workable solution to this dilemma. At the same time we have received more than double our usual number of applications, and we were able to bring in six or seven students with extraordinary qualifications.

Genoa

In attempting to reconcile the time spent in travel and the intensive work effort that occurred during the time in Genoa, Professor Rice had established a well balanced calendar of activities. The visiting European architects complemented the interests of Professor Rice and Dr. Fera by presenting to the students not only what they do but also how they go about doing it within the European methods of design and construction.

Master of Architecture and Health

- This well established program had a new director, David Allison. The students who graduated last year had the distinction of being the only students to study with the founder of the program, George Means; former department head, Ken Russo; and the new director, David Allison.
- Professor Allison has become a member of the AIA/AHA Committee on Health and has initiated several modest public service projects that continue the tradition of service which has been the hallmark of this studio.

Master of Architecture

- The overall quality of thesis work in the Master of Architecture program was outstanding last year. In the selection, exploration and resolution of individually sponsored theses, the students have produced a most remarkably varied set of ideas. Most of the committees were interdisciplinary in nature, often including a variety of members from all parts of the campus as well as professionals from the region.
- In addition to the strength of the thesis work we should cite public service projects for Union, S.C., for Camp Hope, and for the Thurmond Institute (the latter two being here on campus).
- Visiting architects such as Sambo Mockbee (Mississippi) and Thom Mayne (California) have provided our students with a concentrated studio/discussion with leading architects of our time.
- In addition to being a visiting distinguished critic Thom Mayne also served as the University's first "Master Teacher." In this capacity he met with faculty and students in the liberal arts, the sciences, engineering and brought a new level of interdisciplinary thinking to our campus.
- One of our students, Paul Hammond, placed second in an international design competition for a border crossing between the United States and Canada entitled "Site Lines."
- Two new faculty members, Dr. Joe Burton and Professor Rob Miller, complemented the graduate faculty this year, and Professor Durham Crout spent the year at the University of Pennsylvania doing the ground work for his Ph.D. in Architecture.
- Professor Peter Lee has been awarded a Fulbright Fellowship as a senior lecturer to spend the next academic year in Jordan.

Master of Science

This new program which has just completed its first year of operation has four

students working in three current areas of research. These areas include energy, health care and computers. Professor Davis has provided coordination for these programs, initiating new courses in research methods in addition to writing research proposals and grant applications. In this regard a major grant to establish a five-year research program is pending approval at the state level. The Master of Science program will offer opportunities for real inroads into research and into the sciences of our profession.

Remarks

- A variety of our faculty members are active in professional organizations and organizations related to their specific areas of interest. We are very proud of these alliances that keep us in constant touch with other members of our field. Of particular note is Dean Barker's election to the presidency of the Association of Collegiate Schools of Architecture (ACSA).
- We have made a modest advance into the realm of continuing education with both Martin Davis (energy and daylighting) and Richard Norman (computer applications) in conducting workshops for professionals in the region.
- The department reorganization has included the establishment of the role of director for the significant programs both here and away from campus. To better facilitate the academic progress and the day-to-day working of activities, we have restructured the department head's office by asking Sandy Elgin to adopt the role of administrative assistant, and finally, we have consolidated the student organizations to place more responsibility in the hands of the AIS/S and its officers for both semester by semester activities and department governance. By all accounts these three major restructuring efforts have proven to be extremely valuable changes to the ongoing quality of all of the department's programs, activities and events.

Department of Construction Science and Management

General Information

The students, faculty and staff of the Department of Construction Science and Management were involved in many activities and achievements during the 1990-91 academic year. The name change for the department, programs and degrees was approved in January 1991.

The first annual Constructors' Guild Golf Tournament was held in October, netting approximately \$2,000 which was used to support student travel during the year.

The department's annual fund raising campaign brought additional funds of \$4,580 to the department's PDP Account and Endowment during the year. Monies from the PDP Fund have been used to purchase computer hardware and software for the department's faculty and staff.

Research and Public Service Activities

Research and public service activities continued and increased during the year and included the following:

- The Clemson/ABC Partnership continued to be a successful venture. Besides the six Supervisor, four Project Manager and two Safety Manager Academies, two Estimating Academies were offered for the first time. In addition discussions were begun to develop an academy for owners (CEOs) of construction companies. To date, more than 800 individuals, representing more than 300 companies throughout the United States have participated in the academies.
- In co-sponsorship with the S.C. Home Builders Association, three more Graduate Builders Institute courses were offered during the fall semester.

- The department continued to score and maintain the examinations for the S.C. Licensing Board for Contractors.
- The department completed the first stage of its \$80,000 grant from the National Association of Women in Construction to revise the Certified Construction Associate Program curricula. In addition work began on the development of the first in the series of courses. The department received an additional contract with NAWIC to maintain its national examination effort for the CCA Program.
- The department was successful in receiving a \$15,000 grant from the Northern New Jersey Chapter of Associated Builders and Contractors to conduct research on "The Economic Impact of the New Jersey Prevailing Wage Law." The research was completed and final report submitted to the chapter at the end of the academic year.
- The work with Texas Instruments on Quality Management was completed, as was the work for the Construction Industry Cooperative Alliance for research to determine what is being done to attract and train construction workers in the Southeastern United States.
- After months of work the department received a \$110,000 grant to conduct safety-related research for the Construction Industry Institute. This will be a 2 1/2-year effort and will be led by Dr. Liska as project director and utilize the assistance of two graduate students in the department as part of their thesis research.
- The department began work on a proposal to the Commission on Higher Education for a Clemson University Center for Construction Education and Research. The proposal will be completed and submitted to the commission during the 1991-92 academic year. If approved the center will become the research and educational development arm of the department.
- Another significant accomplishment of the department was being selected to develop and conduct a one-week Construction Supervisor Institute for the Carolinas Associated General Contractors Project SuperVISION effort, using the same instructors and materials being used for ABC's Supervisors' Academy. The first institute will be held in February 1992, with a second one possible during the same month.
- Work also began on the development of a participant and instructor manual on Construction Quality Management for the National Office of Associated Builders and Contractors. Once published the material will be used to train construction company owners and managers in the total quality management process.
- Since the department has become involved in service and research activities its national visibility has increased substantially. It has been decided to make available the various reports of its research to the department's alumni and others interested in the particular subjects being studied. This effort will be formally implemented during the 1991-92 academic year as a means of technology transfer to help the construction industry solve the many problems it faces.
- To help the construction industry solve specific problems and to provide construction-related and research/development experience for graduate students, the department embarked on a new internship program. This program provides the opportunity for graduate students to work one semester with a specific construction company to solve a construction-related problem which they do not have the skills and resources to solve themselves. The first such internship was initiated during the 1990-91 academic year. This trial effort will be evaluated during the 1991-92 academic year and a final decision made whether to require it as part of the graduate program.

Administration/Faculty/Staff Activities

- Dr. Roger Liska completed his two-year tenure as president of the American Council for Construction Education and, as immediate past president, will continue to serve on the National Executive Committee and head a special effort to increase the membership of the council. Work progressed on a book, *Construction Estimating*, co-authored with Professor Steve Schuette, which is to be published by McGraw-Hill. Dr. Liska also signed a contract to write a book on indoor air pollution. He had a paper published on the importance for contractors to become involved in research for the industry in ABC's monthly journal, *Builder and Contractor*.

Faculty in the department were busy fulfilling assigned teaching duties, advising students, serving as advisors for student organizations, serving on department, college and University committees, participating in community organizations, attending professional development seminars, workshops, and performing research and public service. Many of the faculty served as officers and committee members of national, regional and local construction-related organizations.

- Professor Clarence Addison served as chairman of the department's SACS Committee and as a member of the University SACS Graduate Committee. He also was the faculty advisor for Sigma Lambda Chi, the honorary construction society.
- Dr. Norman L. Book was on sabbatical during the academic year. Much of his time was devoted to developing a program to select structural systems for architectural projects.
- Professor Gregg Corley served as the faculty advisor to the student chapter of Associated Builders and Contractors and was instrumental to the success of the department's first annual golf tournament. He also served as chairman of the Microcomputer Committee for (national) Associated Schools of Construction. He continued as a research associate on the NAWIC Curriculum Development Project.
- Professor David Egan was awarded honorary membership in the American Institute of Architects. He submitted a paper on "Acoustics of Pulpit Canopies" to *Architecture*. In addition he revised pages on acoustics and fire safety for the 9th edition of Wiley/AIA's *Architectural Graphics Standards*.
- Professor Francis Eubanks was awarded tenure during this academic year. He was master of ceremonies at the 1991 College Honors Day. He received the second Departmental Faculty Enhancement Award and also a grant from the McClure Endowment Fund. He submitted and had accepted a paper to be published in the *Journal of Property Finance*.
- Professor John Mumford continued as research associate for the National Association of Women in Construction Curriculum Development Project. At the national meeting of National Association of Home Builders, as faculty advisor for NAHB Student Chapter, he led a group of our students in a competition. This was the first time our department participated, and we placed sixth out of 10.
- Professor Steve Schuette served as regional director to the National Board of Associated Schools of Construction and on the National Board of American Institute of Constructors. He served on the National Educators Advisory Committee for Associated Builders and Contractors and instructed in 10 continuing education courses as part of the ABC/Clemson Partnership.
- Patricia B. Durham served as a member of the College Space Utilization Committee and as recording secretary for the Clemson Chapter of Professional Secretaries International. Ms. Durham was elected to honorary membership in Sigma Lambda Chi, the honorary construction society.

- Reta C. Hancock attended two seminars offered at Tri-County Technical College and the 4th Annual AMA Videoconference for Secretaries sponsored by the Clemson Chapter of Professional Secretaries International and the University.

Landscape Architecture Program

The Landscape Architecture Program continued to evolve at such a pace that it was difficult to keep up with all the areas in which we were involved. Previous initiatives were maintained, and both students and faculty continue to initiate new ones. The resulting program visibility will promote growth and status as we approach the assessment processes of the Commission on Higher Education and the Landscape Architecture Accreditation Board.

Beginning with the fall of 1990 the Landscape Architecture Program occupied a "stand-alone" studio space. The students did a great deal of work in making this space their own with a "paint and fix-up program." (With pride in the program's growth they will, nevertheless, give up this space and move on to even larger quarters.)

The Landscape Architecture Program at the 1992 Honors and Awards Day Ceremony will be visible by recognition of outstanding achievements by third year, fourth year and rising fifth year students. The third year award, tentatively called the "Faculty Award," must be supported by nominal program funds while the fourth year award, called the S.C. Chapter – American Society of Landscape Architects Award, will be supported by the chapter. The fifth year award will be in the form of a \$1,000 CAF Scholarship established earlier for each of the college programs.

The Landscape Architecture Program successfully recruited Ms. Marvolyn Alexander to the faculty at the rank of instructor for fall '91. We were able to do this by creatively packaging the college, the Landscape Architecture Program, the Master of City Regional Planning Program and the University's Affirmative Action Program.

The fall of '92 will see the program exceed 60+ students and the advent of the first "full-blown" classes at the fourth year level. The following year will see the "Professional Year" course work, the first landscape architecture final projects and our first graduates. For these historical milestones to be met, an increased share of University and college resources must be committed to the program.

Much has been accomplished. Much more will need to be accomplished with respect to record keeping and documentation if we are to successfully prepare for the upcoming CHE/LAAB assessments.

Program Milestones

- The program successfully hosted the annual meeting of the S.C. Chapter of the American Society of Landscape Architects.
- The program had the first showing of the work by its students during the Rudolph E. Lee Gallery summer exhibition.
- Scott Sonnenberg joined the program as an adjunct professor to teach a course in landscape architecture technology.
- The program enrollment grew to 45+ students and will have 60+ students for the fall semester.
- Peter Walker, an internationally renowned landscape architect from San Francisco, spoke at Clemson as a part of the CAF Lecture Series.

Significant Faculty Accomplishments

- Professor Collins (with Architectural Studies Professor Harritos) received an American Institute of Architects Design Education Award for an innovative second year studio.
- Professor Chamberlain completed her three-year term on the Editorial

Review Board of the *Journal of Architectural Education* (JAE) and has been reappointed for an additional three years.

- Professor Tai was appointed to a faculty summer position at the Governor's School for the Sciences at the College of Charleston.
- Professor Chamberlain has been appointed to head the Clemson Architectural Foundation Lecture Series for '91-92 and '92-93.
- Professor Chamberlain traveled with a CAF grant in Europe in support of her innovative teaching of landscape architecture history. Professor Tai traveled in Europe in support of her studio teaching efforts.
- Professor Tai was selected to teach at the Clemson University College of Architecture Center at the College of Charleston for '91-92.
- Professors Collins, Chamberlain and Tai represented the University in Denver at the annual meeting of the Council of Educators in Landscape Architecture.
- Professor Collins attended the Association of Collegiate Schools of Architecture's Annual Program for Deans and Department Heads in Phoenix.
- Professor Chamberlain juried the N.C. Chapter, American Society of Landscape Architects Biannual Awards Program.
- Professor Tai was an instructor at the SC-ASLA sponsored graphics workshop held in Charleston in June. Professor Collins was a participant.
- Professor Collins attended the Urban Forestry Conference held in Columbia.
- Professors Chamberlain and Tai were reappointed to their tenure-track positions for next year.
- Professor Collins, as a public service commitment, continued to serve as a captain with the University Fire Department. Professor Collins designed an innovative fire engine for the department, and it is under construction in Ohio. For his efforts he was given the department's 1990 Firefighter of the Year Award.
- Professor Collins completed the first phase of the renovation of College Avenue in the City of Clemson. Professor Collins (with Professor Harritos) also completed work on the Keith Street Cafe restaurant.

Significant Student Accomplishments

- Twenty-three Landscape Architecture students made the Dean's List.
- The Clemson Student Chapter of the American Society of Landscape Architects received official recognition from the Office of Student Government. This means the chapter will receive some funding for '91-92 to support activities.
- Eighteen students attended LABASH at Kansas State University. LABASH is an annual convention of students in Landscape Architecture. Clemson had the second largest contingent in attendance. Students already are making plans to attend this year's LABASH at the University of Texas at Arlington.
- Matt Compton, third year student, has been a moving force in campus recycling efforts.
- Seven students participated in the SC-ASLA sponsored graphics workshop in Charleston in June.
- Robert Anderson (BS Design – Landscape Architecture '91) has been accepted to the Master of Landscape Architecture program at N.C. State University.

Department of Planning Studies

The department enjoyed a very successful year as measured in terms of total enrollment, number of graduates, curriculum implementation and focus.

- There were 49 students in the MCRP program in the spring semester 1991, representing 32 percent of the total graduate enrollment in the college.
- The number of applications and admissions continued to increase significantly over previous years.
- All the students enrolled in Thesis/Terminal Project completed and successfully defended their work. Of 19 candidates in the spring, 17 received degrees at the May graduation. Both of these are new "highs" in the 23-year history of the department.
- More than \$400,000 was granted to the department by HUD to support economically disadvantaged students as a result of a grant application written by Dr. Herbert Norman. Another grant of \$241,880 was announced in the summer for the period of 1991-93.
- At the end of the summer the department had secured 10 positions for Public Service Assistants, 16 Work Study positions funded through the HUD grant, in addition to 14 graduate assistantships. This represents a total of 40 students receiving some form of financial aid.

The department also has strengthened its faculty resources, particularly in the area of physical planning and increased its research component.

- Professor Robert Bainbridge (BArch Berkeley, MArch in Urban Design at Rice) taught two classes in the spring and will continue for another year as a visiting professor. Professor Bainbridge has been elected president of the Palmetto Trust for Historic Preservation in South Carolina.
- Professor Kerry Brooks' proposal to SUN Computers brought to the college a donation of equipment valued at \$259,470. He also has participated in sponsored research applying geographic information systems techniques to climate studies and to modeling economic impacts of infra-structure investments.
- Professors Jose Caban and Herbert Norman attended the Annual American Planning Association Conference in New Orleans. At the conference Professor Caban assumed the responsibility as chairman of the Urban Design and Preservation Division of APA and editor of the journal, *Urban Design and Preservation Quarterly*.
- Dr. Jim London was on 50 percent leave from the department to direct the University's Environmental Policy Program. Dr. London has been co-investigator in a solid waste management research project along with other academic units of the University. He also coordinated a project on the Impact of Infrastructure Investment for the Appalachian Regional Commission and State Development Board. In July Dr. London presented a paper at the International Planning Conference in Oxford, England.
- Dr. Barry Nock's application for sabbatical leave was approved. He will spend the 1991-92 year at Duke University. He is a visiting professor in the Department of Health Administration where he is team teaching a course in Strategic Management and Planning. He also is a visiting professor at the Center for Policy Research and Education where he is working on two research projects on indigent care.

Department of Visual Arts and History

Art Studio — Faculty Exhibition

The fall semester Lee Hall Gallery exhibition schedule opened with an exhibition of the recent creative work of the studio art faculty. Faculty represented in the exhibition were: John Acorn, sculpture; Tom Dimond, painting; Terry Jarrard-Dimond, sculpture; Mark Hudson, painting; Robert Hunter, painting; Sydney Cross, printmaking and drawing; Jim Buonaccorsi, sculpture; Mike Vatalaro, ceramic sculpture; and Sam Wang, photography and computer images. The faculty

exhibition is scheduled every two years and provides the college, University and community with the opportunity to view the creative work of the art studio faculty who actively exhibit their work in local, state, regional and national exhibitions.

Visiting Artists Program

There were nine visiting artists/lecturers invited to come to the University during the 1990-91 academic year. This program is a most valuable asset to the department, providing communication and stimulation for students and faculty. It brings new ideas and insights into the department and provides a vehicle for extending the department out to regional and national institutions. The 1990-91 Visiting Artists/Lecturers:

Walter Chappell, photographer, New Mexico
Beverly Heisner, art historian, Columbia, SC
Ned Rifkin, curator of exhibitions, Hirshhorn Museum, Washington, DC
Rae and Mark Mahaffey, printmakers, Gemini G.E.L., Los Angeles, CA
Allison Saar, sculptor, New York, NY
Mary Jane Jacobs, art consultant, Chicago, IL
Glenn Harper, art critic, Art Papers, Atlanta, GA
Curtis La Follette, metals artist, Rhode Island

National Print and Drawing Exhibition

The department and Lee Hall Gallery originated and sponsor the National Print and Drawing Exhibition every two years at Clemson's Lee Hall Gallery. This is a major competitive exhibition which brings national attention and exposure to our department, college and University. This year's exhibition attracted 400 entries that included participation from all 50 states. The juror was Ned Rifkin, curator of exhibitions, Hirshhorn Museum, Washington, DC. Mr. Rifkin is nationally recognized for his work with contemporary artists and art issues. His visit was coordinated with the Visiting Artist Series.

Governor's School for the Arts Relationship

The department has enjoyed a long, close relationship with the Governor's School for the Arts as a supporter and contributor to this excellent program. The department sponsored one of the Outreach Programs in the fall with more than 200 area high school students participating on our Clemson campus. Faculty from the department continue to serve as faculty for the Governor's School for the Arts held each summer at Furman University. In addition many of the MFA graduates of our department now are being selected as faculty as they achieve professional recognition in the field.

Beyond the Zone Workshop

Professor Sam Wang organized a regional workshop that has had national success under the leadership of Phil Davis and Bob Routh who are internationally recognized college professors for their innovative contributions to the field of photography. The workshop was an intense five-day, hands-on experience on techniques for controlling tonal relationships between the subject, film and paper. Unique to the Southeast this workshop attracted participants from Georgia, Alabama and the Carolinas. The S.C. Arts Commission gave a \$1,000 grant to partially finance the workshop. Participant evaluations revealed the high level of professional success of the workshop and recognized the outstanding commitment of Professor Sam Wang to photographic education.

Faculty Professional Activity

- Professor Cecilia Voelker and Professor Linda Varkonda presented research papers at the Southeast College Art Conference in Atlanta. Professor Voelker's paper was "Designated Spaces for Female Monasteries in the

Post-Tridentine Era." Professor Varkonda's paper was "Levinia teer Linc Tudor Limner and Gentlewoman to the Queen." Professor Voelker has conducted research on Staten Island as a continuation of her research studies of "Quarantine Sites on the Atlantic Seaboard." Professor Voelker has prepared her "Translation of Borromeo Treatise" for the Camden Press, Inc.

- Professor Janet LeBlanc was a guest lecturer at the University of South Carolina. Her lecture topic was the work of the international artist, Christo, and her participation with him on a variety of his projects.
- Professor John Acorn received the highest award in the 40th Annual Juried Exhibition sponsored by the Guild of South Carolina Artists and held in the South Carolina State Museum, Columbia. The award was the "1990 Best of Show" presented to Professor Acorn by Sen. Strom Thurmond. Professor Acorn and Professor Tom Dimond were included in the Anniversary Retrospective Exhibition at the South Carolina State Museum, Columbia. Professor Acorn was one of 15 Southeastern artists selected for the Inaugural Exhibition of the new Winthrop College Art Galleries, Rock Hill. Professor Acorn had a One Man Exhibition of Recent Work at the Hampton III Gallery in Taylors. Professor Acorn delivered two slide lectures relative to the exhibition and was the subject of a television presentation by the S.C. Educational Television Network.
- Professor Dimond was a Merit Award winner in Painting at the S.C. State Fair Exhibition in Columbia. He also received the First Prize in Painting awarded in the Annual Juried Exhibition at the Anderson Art Center. Professor Dimond received a Sabbatical Leave Research Grant and a Residency Fellowship at the Vermont Studio Art Center.
- Professor Terry Jarrard-Dimond was part of a two-person exhibition at Columbia College. She also served the S.C. Governor's School for the Arts as a Student Selection Panelist as well as being a faculty member of the Governor's School for the Arts at Furman University.
- Professor Jim Buonaccorsi received the Best in Show and the Martin and Doris Rosen Award in the Rosen Outdoor Sculpture Competition at Appalachian State University. The nationally known art critic, Donald Kuspit, was the juror. Professor Buonaccorsi had his work selected for the following competitive exhibitions: Outdoor Sculpture Exhibition, Cleveland State Community College, Cleveland, TN; Outdoor Sculpture Exhibition, Empire Fulton Ferry State Park, Brooklyn, NY; Sculpture Tour 1990-91, University of Tennessee, Knoxville, TN; Mint Museum Biennial, Mint Museum of Art, Charlotte, NC; "Centenary Coming Out," Outdoor Sculpture Invitational, Centenary College, Shreveport, LA.
- Professor Jim Stockham exhibited his work in a Drawing and Printmaking Exhibition at the Cobb Gallery in Birmingham, AL. He also had an exhibition, "Thermoformed Sculpture," at the T.R. in Atlanta and was one of a Two-Person Exhibition at the Furman University Art Gallery.
- Professor Sam Wang had a One Person Show of his recent Computer Images at the University of Arkansas and was a participant in numerous state, regional and national exhibitions in the 1990-1991 academic year. These included "Statements of Heritage" at the South Carolina State Museum; "Southern Environmental" at the Light Factory, Charlotte, NC; the Annual Juried Exhibition at the Anderson Art Center; "Ultra Large Format Photography" at Virginia Intermont College, VA; "9 South Carolina Photographers" at Anderson College; and "The Auction Show" at the University of Oregon Museum of Art. Professor Wang served the South Carolina State Museum as a member of the Art Acquisitions Advisory Panel. He also is a member of the Advisory Panel to the Appalachian Environmental Arts Center, Highlands, NC, and conducted a Landscape Workshop for the center. Professor Wang was a guest artist at the Penland

School for Crafts, NC, where he taught a computer workshop. He also continued his active participation in the Society for Photographic Education at both the regional and national meetings.

- Professor Sydney Cross' art work was selected for the Parkside National Small Print and Drawing Exhibition, Kenosha, WI. She was one of a Two-Person Exhibition for the Association of Visual Artists, Chattanooga, TN, and was part of a Group Exhibition at Gallery 291 in Greenville. Professor Cross also participated in a national Portfolio Exchange entitled "Images 1990."
- Professor Mike Vatalaro conducted visiting lectures and workshops at the University of Chattanooga, Mississippi State University, Brevard College, NC, and Anderson College. His ceramic sculpture was exhibited at the Association of Visual Arts in Chattanooga, TN, and at the S.C. Crafts Association Juried Exhibition at the Anderson Arts Center.
- Professor Mark Hudson exhibited 14 of his most recent works in painting at a Two-Person Exhibition at Columbia College.
- Professor Robert Hunter is in the process of assembling pictures of recent work using the computer. This is part of his research into computer applications and their relationship to freehand drawing.

COLLEGE OF COMMERCE AND INDUSTRY

School of Accountancy

During the 1990-91 academic year the School of Accountancy graduated 101 Bachelor of Science students and 22 Master of Professional Accountancy students. Of the Bachelor of Science graduates 21.8 percent graduated with University honors. David W. Garrison, who received his undergraduate degree in December, was recognized by the University faculty with the Norris Medal. The medal is given each year to a graduating student, who, on the basis of exceptional scholastic achievement and leadership ability, is judged to be the best all-around student. Placement of undergraduate and graduate accounting students continued to compare favorably with national averages. The School of Accountancy is recognized as a primary recruiting school for major accounting firms in Georgia and the Carolinas. Fall enrollment in the undergraduate and graduate accounting programs totaled 544 and 56, respectively. Since 1986, enrollment in the undergraduate program has grown 12.8 percent. The graduate program has grown 300 percent during the same period.

Faculty research productivity continues at a strong pace. During the year the faculty had seven journal articles and five books published or accepted for publication. Faculty presented three papers at regional professional meetings, three papers at national professional meetings and one paper was presented at an international accounting conference in France. Faculty publications included articles in *Journal of Business Ethics*, *International Journal of Accounting Education and Research*, *Journal of Financial Planning*, *The Bankers Magazine*, *Management Accounting*, *Review of Taxation for Individuals* and *Journal of Applied Business Statistics*. During the 1990-91 academic year, School of Accountancy faculty were recognized for their contributions to accounting and taxation literature. In an article entitled "A Taxonomy of Content and Citations in the *Journal of Accounting Education* (1983-1989)," published in the spring 1990 edition of *Journal of Accounting Education*, Professor Joe Louderback was cited as one of the 34 most cited authors in the journal. His textbook, *Cost Accounting: Accumulation, Analysis and Use*, was recognized as one of the most cited monographs and books in the same journal. In an article entitled "Measuring Tax Faculty Research Publication Records" that appeared

in the fall 1990 edition of *The Journal of the American Tax Association*, Clemson was ranked 19th nationally in terms of the number of tax articles published in academic and professional tax journals in the period 1981-1988. This accomplishment is particularly noteworthy in that Clemson was one of only seven schools cited in the top 35 not having a doctoral program in accounting. Also, this record was accomplished by Professors Tom Dickens and Steve Cash who have been at Clemson since 1983 and 1982, respectively.

The internal auditing program continues to attract a significant number of students. The program has received outstanding support from the internal auditing professional community in manufacturing, retail and financial institutions. Placement of internal auditing students in permanent and internship positions has been excellent. During the 1991 summer break, 20 rising seniors participated in internship positions with corporations and agencies throughout the Southeast. These included Springs Industries, NCNB, Sonoco Products, Duke Power, S.C. State Auditor, Blue Cross/Blue Shield of South Carolina, First Union Corporation, Carolina National Bank, Prudential Reinsurance, C & S/Sovran, First Savings Bank of South Carolina and SCANA.

In the professional service area five faculty members have served on national boards or committees of professional accounting organizations. Several continue to hold office in local and state chapters of professional accounting organizations.

Department of Economics

The 1990-91 academic year was marked by concentrated efforts aimed at improving both graduate and undergraduate education. At the graduate level, Cotton Mather Lindsay, J. Wilson Newman Professor of Managerial Economics, was named graduate coordinator. Under his leadership a wide-range recruiting campaign was undertaken. These efforts culminated in the arrival of 36 new students starting graduate work in economics in the fall of 1991. This enrollment is more than double the size of the largest class ever. Of these, three had GRE scores in excess of 1,900 (out of a possible 2,400); 19 had scores above 1,700. Eleven of the new students are foreign. Most of these come from India, China and Taiwan.

The professional record of the faculty during the year was notable. This year articles by our scholars appeared in the *Journal of Labor Economics*, *Quarterly Journal of Economics*, *Journal of Money, Credit and Banking*, *Journal of Economic Literature*, *Review of Economics and Statistics*, *Public Finance Quarterly*, *Public Choice*, *Canadian Journal of Economics*, *Economic Inquiry*, *Harvard Journal of Law and Public Policy*, just to mention the top ranking journals. In addition to the sizable volume of this research its quality continues to attract the attention of the leading scholars in the field. Faculty received research support from many sources including most prominently the National Science Foundation.

The faculty presented papers at numerous meetings and gave seminars across the country. To mention a few, papers were given at the 6th World Congress of the Econometrics Society, the Association Francaise de Finance meetings, the European Association of Law and Economics, the conference on Economics of Cities of the Arts: The Case of Venice, the Public Choice meetings, the Southern Economics Association meetings, the Southern Finance Association meetings, University of Chicago, Stanford University, George Mason University, Florida State University, Auburn University, the University of South Carolina, Montana State University, Washington University, UCLA and the World Bank. In addition numerous op. ed. and newspaper editorials were contributed by the faculty.

Nationally prominent guest lectures gave seminars during the year. These included Ken French, University of Chicago; Lisa Meulbroek, Harvard University; Jeffrey Netter and Annette Poulsen, University of Georgia; John Long, University of Rochester; Steve Smith, Georgia Institute of Technology; Gordon Tullock, University of Arizona; Velma Montoya, UCLA and the Consumer Product Safety Commission.

Undergraduate studies continues to be the foundation of our department even as we pursue research goals and expand our graduate offerings. Based on an endowment created last year by the Harris Family Trust we were able to invite a nationally prominent economist to visit for a week. James C. Miller III, gave a series of lectures to the undergraduate students, highlighted by the dinner speech at the seniors' banquet. Professor Miller is a Ph.D. economist trained at the University of Virginia. Academically, Professor Miller has written prolifically on regulation and deregulation. Because of his background he was appointed to two key positions — chairman of the Federal Trade Commission and director of the Office of Management and Budget — during the Reagan presidency. His vast experiences and lively style made Professor Miller a big hit with the students.

Two Ph.D.s in Applied Economics, nine Master of Arts, and 51 Bachelor of Arts and Bachelor of Science degrees were granted.

Department of Finance

The Department of Finance continued to be among the nation's leaders in undergraduate finance education in 1990-91. With about 950 majors the financial management (FM) program is among the two largest majors at Clemson. FM graduates continue to be highly sought by firms throughout the nation. This is partly because FM majors take a more rigorous program of accounting and finance courses than students in finance programs at any other university anywhere.

In the area of private financial support NCNB National Bank of South Carolina announced last February its major commitment of \$500,000 to establish and fund the NCNB Communications Initiative in Financial Management. This unprecedented support will allow us to give finance students "world class" training in speaking, writing and negotiating skills.

Clemson's finance faculty strives to conduct research that is both relevant and of value to students in the classroom. Three faculty members had particular success this year. Wayne Marr, First Union Professor of Banking, and Professor Mike Spivey published two important papers in major journals. In the *Journal of Financial Economics* they addressed how different plant closing decisions affect the market value of firms. Their other paper on underwriter certification and its applied insurance effect on sales fees was published in the prestigious *Journal of Financial and Quantitative Analysis*.

Professor Harold Mulherin co-authored a paper for the *Journal of Law and Economics*. His paper tested a theory of how stock exchanges are organized to reduce transaction costs. Mulherin also published a case study of the enforcement of information property rights at the Chicago Board of Trade. This article appeared in the *Review of Futures Markets*. Harold Mulherin was on leave at the Securities and Exchange Commission.

Next year the department will lose the services of Eurico Ferreira to Indiana State, but it will get Harold Mulherin back from the SEC. He will be joined by Yong-Cheol Kim (Ph.D., Ohio State University) who is coming to us from Baruch College at the City University of New York.

Department of Management

The Department of Management, under the leadership of a new department head, Dr. William H. Hendrix, made great strides in positioning itself for the 1990s. Consistent with the global outcry for quality, the department embarked on an ambitious program called Academic Total Quality Management (ATQM). The program works well in industry; however, the Department of Management is one of the first academic units in the country to adopt it.

At its inception the entire department spent several afternoons learning about ATQM and deciding how to implement the program. Faculty also developed a vi-

sion statement and discussed the four most important clients of the department: students, the business community, the University and other universities. Representatives from each academic discipline group in the department continued to meet regularly.

One of the keys to success in the ATQM program is reaching out to students and alumni to monitor satisfaction and determine how to improve management programs. To this end the department surveyed both alumni and graduating seniors. Overall, both groups expressed satisfaction with their experiences at Clemson and the value and quality of Management programs. On teaching effectiveness, for example, nearly half of the alumni surveyed thought management professors were better than other Clemson professors, with the rest responding that management professors were equally as good. Seventy percent of those surveyed thought the department ran its programs and offices efficiently and effectively. Nearly all graduates surveyed felt the program had helped them grow personally and professionally. In addition many helpful suggestions were made on how to improve management programs.

The department also launched *Management Update*, a newsletter for alumni and friends. The first issue featured a note from Dr. Hendrix and an article by Dr. R. Lawrence LaForge entitled, "The Concept of World Class Manufacturing." The newsletter also solicited ideas and suggestions from alumni. Another communications effort resulted in the publication of a three-fold color brochure that details Management programs.

Dr. Hendrix formed committees during the year to work on important departmental issues. The Research and Service Effectiveness Committee met weekly to improve guidelines for evaluating faculty performance. The Teaching Effectiveness Committee generated a new teacher evaluation instrument.

To help satisfy the growing demand for management courses the department hired Dr. Philip Roth, a 1988 Ph.D. from the University of Houston. Dr. Roth, who was teaching at San Diego State University, has an outstanding research and teaching record. The department also was recruiting for two other much needed positions, but state budget cutbacks in the middle of the year stifled recruiting efforts.

The quality of the faculty was recognized both internally and externally. Dr. R. Stephen Cantrell was promoted to professor. Dr. John Stephen Davis was awarded tenure. Both Dr. Richard L. Clark and Dr. Jeffrey S. Harrison were promoted to associate professor. Externally, Dr. LaForge and Dr. V. Sridharan were appointed to the editorial review board of *Journal of Operations Management*. Dr. Harrison was appointed to the board of *Academy of Management Executive*. In addition Dr. Sridharan was invited to visit the Graduate School of Industrial Engineering at Eindhoven University of Technology, Netherlands, to conduct research and teach a seminar.

It also was a good year for external funding. Dr. LaForge was awarded \$27,355 from the State of S.C. Cutting-Edge Research Investment Fund to pursue a project entitled, "Applications of Information Technology to Manufacturing Management." Dr. Caron H. St. John and a doctoral student, Kirk Heriot, completed work on a \$60,000 grant from the Small Business Administration to study the federal reporting system used to monitor small business subcontracting. John J. Kanet completed work on a \$573,591, two-year project on branch-and-bound based search algorithms. Dr. Sridharan was awarded \$15,000 from Siemens Corporate Research, New Jersey, to work on "Decision Support Systems for Manufacturing Planning." The department also awarded four faculty with summer research grants to work on a variety of topics.

Research contributions by management faculty appeared in the best journals in the field, including *Decision Sciences*, *Journal of Management*, *Organizational Behavior and Human Decision Processes*, *Strategic Management Journal*, *Academy of Management Executive*, *Journal of Operations Management*, *Industrial Relations*, *Human Relations*, *Journal of Applied Psychology*, *Journal of Business Ethics* and many others. In fact, publications and presentations by department facul-

ty numbered approximately 60 during the year. Dr. David W. Grigsby (with Michael J. Stahl) completed work on a book, *Strategic Management Decision Making*, which will be published by Southwestern in early 1992. *Personnel/Human Resource Management*, by Dr. Michael D. Crino and Dr. Terry L. Leap, was published by Macmillan. Dr. Leap's book, *Collective Bargaining and Labor Relations*, also was published by Macmillan.

Department of Marketing

During the 1990-91 academic year the Department of Marketing graduated 172 students with a Bachelor of Science degree. The department continues to attract students. Presently, the department has approximately 700 majors, making it the fourth largest department in the University. In addition marketing continues to be a popular minor attracting students from management, finance, economics, psychology, L&IT, recreation, construction management and sociology.

Two new tenure-track faculty have been added, bringing the number of marketing faculty to 12. Dr. Gregory Pickett, assistant professor, comes to Clemson from Northern Arizona University where he spent six years. Dr. Pickett is an outstanding teacher and researcher, and his presence will strengthen the department. Dr. Patricia Knowles also will join the faculty after completing her post-doctoral studies at the University of Georgia. Dr. Knowles, with her background in experimental psychology, has outstanding methodological expertise. Her presence will significantly enhance the department's research productivity.

In the 1989-90 academic year the Marketing Department revised its curriculum and decided to offer concentrations in "Technical Marketing" and "Services Marketing." Although new courses still are being developed, these concentrations now are in place, and students entering the University during the 1991-92 academic year can elect a course of study in either of these concentrations. Further, the department is working on a proposal for a master's program in Technical Marketing. We also are seeking external support for a faculty chair in Technical Marketing.

The 1990-91 academic year was another excellent one for the department in terms of research and publications. Faculty research was published in a wide variety of scholarly journals including the *Journal of International Consumer Marketing*, *Journal of Advertising*, *Journal of Marketing Education*, *Journal of Academy of Marketing Science*, *Journal of Business Logistics*, *Journal of Services Marketing* and *Journal of Personal Selling and Sales Management*. Further, the marketing faculty presented numerous papers at all of our most prestigious national meetings: American Marketing Association Summer and Winter Conferences, the Association of Consumer Research Meeting, and the Academy of Marketing Science Meeting. One-half of the faculty now serves on the editorial boards of scholarly marketing journals; several hold offices in local, regional or national associations.

The marketing faculty provided service to the University and the larger community as well. Dr. Waddle, for example, serves on the Faculty Senate, chairs the University Grievance Committee, is the college representative for Calhoun College and serves on numerous advisory boards throughout the University. Two of our faculty members received grants and are working on studies vital to the University and to South Carolina. In addition, marketing faculty undertook studies to assist local area businesses, including but not limited to, the Greenville Chamber of Commerce, Economic Development Group for Abbeville and McCormick Counties, Peeler's Dairy, Los Hermanos Mexican Restaurant and Seneca Marina.

School of Textiles

During the 1990-91 academic year the School of Textiles graduated one Ph.D. student, four M.S. students and 27 B.S. students. Placement of these graduates continued to be high as in previous years with all graduates seeking employment

being placed. Enrollment in the undergraduate programs was at its highest level in several years with 194 students enrolled in the three undergraduate programs. The number of graduate students enrolled continues to be limited by the funds available for assistantships. Some success was made in continued efforts to seek outside research funding for graduate students.

Sponsored research continues to receive emphasis in the school. Two new proposals were funded this year (Ashland Carbon Fibers and Boeing Commercial Airplane Group), and a number of proposals have been submitted to other funding agencies such as the U.S. Army NATICK RD&E Center, NASA and EPA. Also, efforts are continuing to obtain federal funding for the research consortium involving Auburn, Clemson, Georgia Tech and N.C. State. Work also is in progress to bring together an alliance of fiber producers and machinery manufacturers along with Clemson to carry out research and machinery evaluations in the polymer fiber extrusion area.

We have continued to enhance our laboratories through acquisition of equipment; mostly through donations. This serves both our research and teaching efforts.

The public service component of our mission has been supported well this year with approximately \$75,000 billed to firms for special testing and small project/consulting efforts performed in our laboratory facilities. Numerous additional consultations were provided by the faculty on a no fee basis.

Office of Professional Development

The Office of Professional Development had another excellent year in 1990-91, offering high quality training services to 17,247 enrollees in 600 public seminars, conferences and workshops throughout the nation.

We also took our services to business, industry and service organizations in record numbers, offering private in-company training sessions to 2,150 of our clients' employees.

Here are some of the highlights we achieved this fiscal year:

- Established an organization entitled, The Alliance for P.E.O.P.L.E., created its superlative advisory board, and began preparations for its inaugural conference May 4-6, 1992, at the Stouffer Waverly in Atlanta. The conference title is "How to Challenge, Motivate and Build Your People to Achieve Organizational Success." P.E.O.P.L.E. is an acronym for The Promotion of Excellence in Organizations through Productivity, Leadership and Empowerment.
- Produced 48 technical conferences primarily in textiles and apparel which offered more than 3,000 people a broad range of knowledge on topics critical to one of the South's largest industries.
- Hosted an international fiber, textile and apparel audience at a blockbuster two-day Microfiber Technology conference. People from the U.S., Canada, Mexico, Thailand, England, Taiwan, South Africa, India and Switzerland made up an audience of almost 200 people.
- Held conferences devoted to the professional enrichment of women as far away as Anchorage, Alaska, San Juan, Puerto Rico, San Diego, California and Nashua, New Hampshire. In all, 35 conferences attracted 6,851 attendees. The most active market was Atlanta where we held two separate Professional Development for Women conferences with total enrollment of 676.
- Developed 15 more conferences this year in the Professional Development for Women product line to expand the total from last year's 20 conferences. In doing so we explored nine completely new markets from coast to coast with a total added enrollment of 1,870.
- Continued to forge new international bonds by developing three- to six-month tutorial training programs for Third World clients of the Agency for

International Development. Our guests were from Tanzania, Egypt, Jordan and India.

- Expanded the Quality Forum to accommodate the demand for one of its original eight seminars designed to equip the 20th century manager with the skill to fuse "quality" management with proper statistical technique and interpretation. Quality Management in the Lab drew such attention that three additional sessions had to be scheduled to handle the needs of 130 quality assurance managers.
- For the first time, offered high-tech computer course in 15 cities across the country. In 15 sessions of the two-day High Performance LAN Cabling Systems, we attracted 282 attendees. We ventured into such markets as Chicago, Baltimore, Dallas, Houston, Detroit, Minneapolis, Tampa, Philadelphia and Kansas City.
- Also, in cooperation with the University's Dropout Prevention Center, Professional Development offered 34 seminars on Effective Dropout Prevention for guidance counselors, principals and teachers in cities throughout the U.S. More than 1,300 educators took advantage of the opportunity.

Small Business Development Center

The Clemson University Regional Small Business Development Center continued to assist the small business community in the 11 Northwestern counties of South Carolina. Through its administrative offices located on campus and three area offices located in Greenville, Spartanburg and Greenwood, the SBDC has fostered economic development and growth. During the past fiscal year the Clemson SBDC has assisted more than 1,000 clients. Trends indicate that the Clemson SBDC operation once again will conclude the year in excess of annual goals. In addition the Management Training Division conducted more than 20 seminars on current and diverse small business management topics.

The center's core program of management assistance and training is funded jointly by the U.S. Small Business Administration and the State of South Carolina. The core mission of the SBDC is to provide management and technical assistance to small businesses to reduce the small business failure rate. In addition the center administers a Defense Logistics Agency grant for the establishment of a state and federal procurement assistance program for small businesses. As a result of this program, now in its fourth year, several large procurement contracts have been awarded to small businesses in the Clemson area during a period of unprecedented growth for this program.

The Clemson SBDC continued to move into areas beyond its core mission. SBDC staff have been involved during the past three years with a W.K. Kellogg Foundation grant for rural leadership education. As a result of remaining highly visible on campus the SBDC also has assisted other University departments and colleges with strategic planning and operations management issues.

A new program has been established in the area of technology transfer. The Clemson University SBDC, in partnership with the Southeast Manufacturing Technology Center at the University of South Carolina, is serving as coordinator between the colleges and universities of South Carolina which develop technology and the small business community. As a result the close partnership with the Clemson University Emerging Technology Center remains strong. Under the auspices of this program a new Energy Conservation Program is in its early stages. This program will educate small businesses as to energy saving techniques that may be implemented in day-to-day operations.

Stronger working relationships have been established with several other state agencies and professional associations such as the State Development Board, the Governor's Office, the State Board for Technical and Comprehensive Education,

the S.C. Economic Developers' Association and the National Contract Managers' Association.

COLLEGE OF EDUCATION

The College of Education, in a variety of efforts ranging from increased grantsmanship and research activities to collaboration with school districts to strategic planning, maintained its momentum for improvement and enhancement of its academic performance during the 1990-91 session. In the traditional academic areas of teaching, research and service, the college achieved measurable success and marked improvement as compared with the previous year.

Its widely divergent departments, offices of operations and support services reflect in their respective annual summaries a commitment to the college's priority on improvement. Included in the College of Education are the Department of Elementary and Secondary Education, the Department of Industrial Education, the Army and Air Force ROTC programs, the Office of Educational Research, the Office of Extension and Public Relations, the Office of Field Experiences, and the Office of Educational Services and Placement.

Department of Elementary and Secondary Education

Instruction

The mission statement adopted by the Department of Elementary and Secondary Education included the following: (1) prepare teachers for employment in public and/or private schools, (2) provide graduate programs for educators and personnel of community and state agencies, (3) engage in public service activities with educational entities and state and community agencies, and (4) conduct research and scholarly activities related to public and faculty interests.

The department's faculty have focused on all the areas of teacher preparation, continuing education conducted through graduate degree programs, extension courses, and in-service workshops as well as continued growth in research and scholarly activities. Faculty members have access to network computer equipment and are being trained to implement computer instruction into methods courses, along with higher-order thinking skills and strategies for writing-across-the-curriculum program initiatives.

Expansion in the college has continued as reflected in student enrollment figures. There were 1,227 undergraduate students and 1,219 graduate students enrolled for spring 1991.

Bachelor of Arts degrees are offered in early childhood, elementary, secondary and special education. Science teaching is an additional undergraduate program granting a Bachelor of Science degree. Master of Education degrees are available in the areas of administration and supervision, counseling and guidance services, elementary education, reading, secondary education and special education. The administration and supervision program has an approved Specialist of Education (Ed.S.) degree program.

The Department of Elementary and Secondary Education continued its commitment to place undergraduate students in practical public classroom experiences. The first course in which education majors observe in the public schools, ED 100, had an enrollment of 533. Foundation and methods courses likewise provided frequent visits arranged for 445 students to experience the classroom environment. The early childhood and elementary field experience courses, ED 400/401, provided 149 undergraduates with similar extended experiences and ED 496 provided one student with special education field experience.

Special education enrolled 19 students (undergraduate and graduate) in practica

courses. The guidance and counseling program had 52 elementary and 31 secondary placements, 21 postsecondary placements, and 25 community agency placements in practica. Administration and supervision provided practica for 25 students in ED 723 for the elementary principal, 21 students in ED 724 for the secondary principal, and five students in ED 725, a course for superintendents.

Proposed Ph.D. programs in science education, in curriculum and instruction, and in educational leadership were reviewed at the University level and are being evaluated by the Commission on Higher Education.

Funding continued for the S.C. Center of Excellence in Math and Science Education. The center has provided courses for teacher certification in math and science and conducted inservices for continued improvement of teaching skills. A consortium of universities and colleges focused on ways to assist elementary and secondary schools in the area of restructuring. Clemson was named college partner on three restructuring grants submitted by area schools.

On the current topic of at-risk students, the "Visions for Youth" project, funded by the Kellogg Foundation, provided outreach programs aimed at the prevention of potential dropouts. Also, graduate courses on substance abuse were developed and funded to further educate teachers about drugs and alcohol. The Reading Recovery program centered at Clemson recently was awarded first place in statewide competition by the S.C. Association for Supervision and Curriculum Development. The program, a research-based approach to providing reading skills for children with identified deficiencies, is internationally recognized.

Inservice

The Clemson campus was the site for several educational conferences and meetings. The Clemson Reading Conference attracted 400 teacher educators, public school teachers and school administrators from the Southeast. Project L.E.A.D. sponsored a conference to improve leadership skills of school administrators. The Department of Elementary and Secondary Education hosted the annual meeting of the S.C. Council on Social Studies. In further community-based activities, 500 elementary students celebrated Young Authors' Day, and 1,150 fourth graders from Pickens County participated in a Fun and Fitness Classic Day.

Through the Greenville Higher Education Consortium, faculty taught courses in various programs to area students. Similarly, critical needs and EIA courses were contracted with school districts and funded by the State Department of Education. In regards to local inservices, 33 sessions were conducted in area schools. At the national and state levels, six professional workshops were presented.

Research, Grants and Related Activities

Faculty in the Department of Elementary and Secondary Education remained active with regard to publications. Fourteen books, chapters or monographs were published by the faculty. Ninety-seven articles, 51 of which were published in refereed journals, appeared in print. Eighteen unpublished articles and miscellaneous works also were submitted.

Presentations were conducted at many levels. Faculty presented at 24 national, nine regional, 22 state and 28 local professional meetings.

Grantsmanship was evidenced by the 26 grant proposals written. Thirteen of these proposals were funded, adding \$319,507 to the departmental budget. Several faculty members participated in the development of grants.

Recruitment received notable attention by faculty representatives. Teacher cadet programs were established with five high schools, and a Future Teachers' Day was held in March for regional public school students and their counselors. These efforts contributed to an increase of 22 minority students in the department.

Department of Industrial Education

The Department of Industrial Education continued to make significant contributions toward its primary mission of instruction, public service and research. In instruction the 15 full-time faculty assisted by 10 part-time faculty taught 50 different undergraduate and 32 graduate courses during the year. There were 196 classes with more than 2,500 enrolled.

Faculty and students gave time and service to the schools and community in numerous ways, particularly in leadership roles in local and national organizations. Special services were rendered to schools, technical colleges and industry. In-service courses for teachers, administrators and counselors as an orientation to industry were offered to several school districts. Institutes for vocational teachers, technology teachers, and math and science teachers were held to update them in their areas. A special program designed to provide services for the printing and related industries was the industrial training program. Approximately 200 people from this industry came to Clemson to receive specialized training in short, non-credit training sessions.

Several research proposals are pending for the Industrial Education faculty. Four training grants were awarded during the year, and a like number are pending for the coming year. The Industrial Technology program received more than \$25,000 in equipment grants, while the Graphic Communications program received a \$200,000 flexographic press primarily for research in ultraviolet ink curing and a second flexographic press valued at \$1 million for research in the wide-web area. In addition, more than \$250,000 in peripheral equipment, including computer workstations, was donated.

Department of Aerospace Studies

In the Air Force ROTC program, approximately \$160,000 went to 43 scholarship holders during the 1990-91 academic year. A student organization for the AFROTC unit, Angel Flight/Silver Wings, served as regional headquarters and was selected as national headquarters for the coming year. Angel Flight/Silver Wings and Arnold Air Society detachments continued to be very successful, winning more regional awards than any other detachment in their respective categories.

The AFROTC detachment arranged for a visit to the University by the Air Force Vice Chief of Staff, Gen. John M. Loh. Gen. Loh was guest lecturer for the Honors Lecture Series.

Department of Military Science

The academic year 1990-91 was filled with highlights for the Department of Military Science (Army ROTC). Fifteen students were commissioned second lieutenant. Fifty-two scholarships were provided by the U.S. Army, amounting to \$265,000.

A number of initiatives were undertaken by the department to enhance the program and to reflect the University's strategic plan for meeting long-range goals. Noteworthy areas include initiatives with the Clemson sports program; broadening University-community public relations; service; department outreach and name recognition; and rediscovering the University's military heritage. The football team, in conjunction with the president of the University, sent an autographed team photo to Gen. Schwarzkopf during Operation Desert Storm. The entire battalion participated in a recently reinstituted tradition, "beating the drum" for the USC/Clemson football game.

The Society of American Engineers Chapter, sponsored by the department, coordinated with a number of local merchants to collect and forward donations and needed items for mobilized U.S. troops in the Persian Gulf. The cadet battalion

staff took a leadership role in the "Walk on Wednesday" parade; this event was in conjunction with the Political Science Department and was one of many events initiated at Clemson to show troop support during the Persian Gulf Crisis.

During the spring term the Fightin' Tiger Battalion acted as track meet referees for all the track and field competition events held at Clemson. High praise was earned from the participating coaches for this activity.

In service to community and Clemson student body, cadets were active in tutoring and in assisting learning-disabled students off campus. The department's outreach program to three local high schools which sponsor Junior ROTC programs resulted in the schools obtaining superior ratings on national inspections. The departmental organizations (Rangers, Pershing Rifles, Scabbard & Blade) continued their service-oriented projects.

Office of Educational Research

The Office of Educational Research (OER) was established in the College of Education during the 1990-91 academic year. Under the direction of the assistant dean for research, OER provides support to faculty who are engaged in educational research or who are seeking sponsorship of research, instructional or service activities. While the services of OER primarily are directed to the College of Education faculty, the office works through all nine colleges of the University, the National Dropout Prevention Center, the Strom Thurmond Institute, and public and private entities outside the University community.

Increased grantsmanship was evidenced by the 45 grant proposals written, up from 27 the previous year. Twenty-two of these proposals were awarded for a total of \$1,711,537 with eight proposals still pending review. Almost 30 percent of the faculty were involved as principal investigators, with an even higher percentage serving as co-principal investigators. The Industrial Education Department was the recipient of \$1.2 million from industry for equipment, while \$511,537 came from federal and state sources.

Dr. Richard Blackburn, head of the Department of Elementary and Secondary Education, obtained \$6,000 from the State Department of Education for the reading recovery program. A teaching award for \$11,322 was granted to Dr. David Barrett by the University to study the attitudes of adolescents. Dr. Bill Fisk received \$241,187 from the U.S. Department of Education to study workplace literacy in the textile industry. The state continued to fund Dr. Donald Fuhr's L.E.A.D project with an additional \$19,750. Dr. Don Keller continued his work in the area of drug education with funding from the state totaling \$35,667. The University also financially supported Jennifer Krutilla's endeavors with \$2,581 to study the effects of cocaine addiction on infants and their families in upstate South Carolina. Dr. Joellen Harris was awarded \$3,000 for the University's special project to support and maintain cooperative learning from the S.C. Center for School Leadership. Dr. Alfred Newton, Prof. Dan Schmittou and Dr. Henry Pate received awards of \$6,372, \$101,769 and \$18,114, respectively, from the state for instruction in the Department of Industrial Education.

Office of Extension and Public Relations

During the 1990-91 academic year the Office of Extension and Public Relations offered a total of 278 courses enrolling some 235 undergraduate and 3,103 graduate students at off-campus sites throughout the state as well as in neighboring Georgia. Courses included not only offerings in professional education but also in such teacher-oriented, diverse fields as economics, mathematical sciences, agriculture, industrial education, management and nursing.

In the fall of 1990 there were 97 courses offered in the off-campus program, followed by 111 in the spring '91 session and 70 during the summer. These cour-

ses included those that constituted a regular part of the ongoing curriculum at the University as well as specially designed offerings to meet specific needs of individual school districts and other agencies. Regional centers are maintained by the College of Education in Greenville and Greenwood, where regular courses in the program of studies are offered on a continuing cycle.

Twice each academic year, the Office of Extension and Public Relations publishes *The Clemson Educator*, a newsletter for alumni and friends of the College of Education.

Office of Field Experiences

The Office of Field Experiences placed a record number of students (1,622) during the year. A variety of prestudent-teaching observation/participation experiences was arranged for 1,133 students; student teaching placements were made for 290 students; and practica placements numbered 199 with one at the undergraduate level and 198 at the graduate level. Teachers who have been identified to serve as supervisors of student teachers were invited to enroll in a three-hour, tuition-free graduate course, ED 700, Supervising the Student Teacher in the Public School. A total of 85 teachers enrolled in the three sections offered throughout the year.

An additional 43 teachers received APT training through participation in one of the three-day sessions scheduled during the fall and spring semesters. Fourteen other teachers gained re-endorsement as APT observers by participating in a one-day training session. The survey of student teachers and supervising teachers reflected a high level of satisfaction with the supervisory processes used by the college supervisors in their observations and evaluations of student teachers. Approximately 60 percent of the students and the classroom teachers responded to the survey for the fall and spring semesters.

Office of Educational Services and Placement

The Office of Educational Services and Placement continued to expand both the scope and breadth of its activities. The annual Clemson University Teacher Interview Program (CUTIP) resulted in record numbers of participants, including 80 school districts registered from six states and the District of Columbia, 350 attendees and some 1,500 interviews.

Workshops and seminars were offered in the fall and spring semesters to all undergraduates, disseminating information on resume writing and certification (in-state and out-of-state). Student teacher in-service workshops were conducted in the fall and spring semesters to graduating seniors and program completers with information disseminated on interview etiquette and interviewing techniques. District personnel from eight local school districts (principals, personnel directors and superintendents) gave information on what is expected from a first-year teacher, interviewing techniques and district hiring practices.

The annual survey of student teachers and their classroom supervising teachers reflected a strong, positive attitude of University graduates toward the education, preparation and training they received in the College of Education. With 66.5 percent response, results in both the fall and spring surveys were predominantly outstanding to excellent on the effectiveness of the teacher education program.

The office surveyed 440 other institutions throughout the nation regarding the feasibility of implementing a computerized placement service and related topics. The survey determined that a computerized placement service was not feasible at this time but that Clemson is far ahead of other universities in computer usage for placement services. Some of the placement file forms were changed to conform to nationwide standards.

COLLEGE OF ENGINEERING

The fiscal year 1990-91 proved to be one of continued advancement for the College of Engineering. Coming from the ranking by *U.S. News and World Report* as an "up and coming" engineering graduate program during the previous year, the College of Engineering continued to build upon the excellence in its educational, research and public service programs.

One of the most exciting events the college experienced was the inclusion of the Engineering Innovation Building into the State Bond Authorization Bill. With more than 20 years of record growth in enrollment and research, the college has reached its limits in space for both educational and research activities. The S.C. House of Representatives passed a version of the bond bill, yet the Senate was not able to discuss the measure before its mandatory adjournment. At this writing, a special session was called by the governor and the bond bill is one of the measures to be considered. The college and University are hopeful the state will pass the measure, with \$14 million allocated to the vital facility. More about the building and Clemson's contributions are included in this report.

As with any state organization, trying to cover all of the programs of excellence and events of achievement within any document certainly would be a Herculean task. Following is a report which highlights the college's achievements in Clemson's three mission fields: education, research and public service.

Education

As one of the largest academic units within the University, the College of Engineering began fall semester 1990 with 3,208 undergraduate students and 573 graduate students in its 11 academic programs. Between July 1, 1990 and June 30, 1991, the college awarded 457 baccalaureate degrees, 151 master's degrees and 26 doctoral degrees.

This past fiscal year saw approval of a new program by the Commission on Higher Education. The Materials Science and Engineering graduate program will enable the many diverse research programs to offer a master's and doctoral degree in this unique field. With the 1990s named as "the decade of materials science," Clemson stands on the forefront of leading the state in this rapidly developing and important part of South Carolina's economic development.

In the newly renamed Department of Agricultural and Biological Engineering, a revision in the curriculum has been well received by students. Students can choose one of the following four emphasis areas while taking a common core of courses in the curriculum: Natural Resources Engineering, Food Engineering, Biotechnology Engineering and Agricultural Production/Consumer Products Engineering. The first graduates of this revised curriculum will be available for employment in the spring of 1991. The first telecampus course of the department was Solid Waste Management and was taught by Dr. Richard White in spring semester 1991.

To complement the academic year portion of the mechanical engineering honors program, Drs. Cynthia and James Jara-Almonte recently have been awarded a grant from the National Science Foundation to support undergraduate summer research activities. These funds also will attract highly qualified students, including women and minority students, from other universities to the program. These students are excellent candidates for our graduate program.

Within the Department of Electrical and Computer Engineering, the faculty approved a revised electrical engineering curriculum put forth by the curriculum committee in May 1991. The new curriculum is constructed to emphasize fundamental engineering knowledge in all of the mainstream disciplines which electrical engineering comprises. Discussion of E.E. curriculum nationally has returned to fundamental roots under the phrase, "education for life-long learning." The computer en-

gineering curriculum underwent major review in 1989-90 and continues to undergo refinement. Both curricula are structured with accreditation board requirements continually in mind.

In the Freshman Engineering Program, the number of students has grown so that this program is the largest department in the University. To start the 1990-91 academic year, there were 1,446 students in the program; 726 of these were new freshman, 136 were transfer students and 584 were returning students.

Dr. William F. Beckwith is the director of the program and is joined by Dr. J. Larry Josey, coordinator of Engineering 101, who teaches courses for the program as well as serves as one of the academic advisors. Mrs. Shirley Davis and Ms. Eva McLeod also serve as academic advisors/counselors in the Freshman Engineering Program. These counselors continually are serving the program in advisement, study skills workshops and summer orientation.

Two freshman engineering courses are taught by faculty in the program and by faculty from other engineering departments. *Introduction to Engineering* continues to help students in selection of the engineering career field in which they wish to study. Department heads from each engineering department make presentations on the type of work done by engineers in their discipline and on the challenges and opportunities available to the graduates of their program. Also, students are required to develop skills in the use of hand-held calculators through drills and tests. Technical communications, dimensions and units, and graphs and graph paper also are taught in this course.

The second freshmen engineering course is Engineering 180, *Computers in Engineering*. The objectives of the course are to teach computer programming and problem-solving skills. The students are taught how to use the word processing program PC-Write, spreadsheet program QUATTRO, and engineering computation program FORTRAN. All programs are taught using personal computers in a micro-computer laboratory in Lowry Hall.

Academic advising is another major activity of the program. More students are seeking help from the counselors. This is evident from the increase in the advising work load of counselors over this report period. We feel it is important for new students to have a readily available source of academic information and to have someone to listen to them and help them with their campus life problems. Workshops on time-management and study skills are offered. Special effort is given to students who will be transferring from engineering and who need help in selecting a major outside the College of Engineering.

The college continued to attract some of the best and brightest faculty members in the nation to its departments. Two new department heads began their first year during the past fiscal year: Dr. Michael Leonard in Industrial Engineering and Dr. Wilson Pearson in Electrical and Computer Engineering.

Some of the distinguished professorships also were filled during the past year. Dr. Lansford C. Bell joined our faculty as the S.E. Liles Distinguished Professor of Construction Engineering. As expected, Dr. Bell immediately impacted the Construction Engineering and Management Program. He placed two Ph.D. students in two major construction engineering firms, BE&K and Fluor Daniel, where they will obtain first-hand experience on operations within those firms which can be applied to their dissertation topics. Dr. Bell's specialty of electronic data interchange has led to new research funding from the Construction Industry Institute and potential funding from CPAR and AIChE. Dr. Bell certainly is a welcome addition to our nationally prominent construction group. Another recipient of a distinguished professorship who joined the faculty was Dr. Judd Diefendorf, the P.W. McAlister Trustee Professor in Materials Science, and Dr. Rajendra Singh, an expert in III-V electronic materials. Dr. Singh joined the faculty as the D. Houser Banks Professor of Electrical and Computer Engineering.

Early in May 1991, the college held a press conference announcing the appointment of Dr. Frank L. Parker as a Westinghouse Savannah River Distinguished Scientist. Dr. Parker is one of the world's leading authorities on radioactive and

hazardous waste management. As Clemson's first member of either the National Academy of Engineering, National Academy of Sciences or The Institute of Medicine, he will provide leadership for the department in the area of mixed waste treatment and management.

Research

As with education, the College of Engineering is one of the largest research units within the University. During fiscal year 1990-91, the college conducted close to \$20 million in research contracts and grants, and brought in more than \$11 million in new research awards.

Within the Department of Bioengineering, biomaterials research is a multi-disciplinary endeavor requiring collaboration of scientists, engineers and physicians. Very intense and fruitful collaboration continues with the medical staff of the Shriners' Hospital for Crippled Children in Greenville, focussing on three major grants that are pursued jointly between faculty of this department and the Shriners' Hospital: a) Günther Heimke (CU) and Ron Ferguson (SH) spearheaded a project on percutaneous anchorage of prosthetic limbs; b) Dennis Powers (CU) and Ben Allen (SH) studied the pathogenesis of Legg-Calve-Perthes Disease through an experimental animal model; c) Vasanti Gharpuray (CU) and Ron Ferguson (SH) developed mathematical concepts of modeling the mechanical aspects for spinal column support mechanisms. Jonathan Black was instrumental in the development of a major collaboration agreement between the Veterans Administration Medical Center in Atlanta, and this department covering research and graduate educational aspects, to include aspects of rehabilitation.

Spawning from the long-standing collaboration between faculty from this department and individual physicians at the Greenville Hospitals, a major agreement was instituted between the Greenville Hospital System (GHS) and Clemson University to collaborate on various aspects of research and post graduate education campus wide. This further intensifies departmental teaching and research activities, specifically in collaboration with the orthopedic departments within the GHS.

The Bioengineering Alliance of South Carolina, a formal collaborative venture between South Carolina's three research universities, continues to be a very successful research program with world-wide research collaboration and a research budget of almost one million dollars per year. It continues to focus on aspects of CAD/CAM applications for orthopedic implants and receives its support from major companies and foundations.

Within the field of ceramic engineering, the ceramic industry is moving toward computer-operated equipment and computer-assisted data recording and analysis. It is difficult for a university to match industrial capabilities in these areas. However, the Ceramic Engineering Department expanded its research resources in this direction by adding several important items of research equipment. X-ray diffraction is a major characterization tool for all materials, especially ceramic materials. The department was without this important characterization method for two years because our Norelco equipment could not satisfy present state regulations. The major acquisition was a Scintag X-ray diffraction apparatus with a multi-sample powder diffraction stage, a high temperature powder diffraction stage and a stage equipped to change the orientation of fibers or wafers during analysis. Re-establishing this important capability already is resulting in some significant new research findings in carbon fiber work.

The word "collaboration" is key to many of the research activities being conducted in chemical engineering. One example is Professor Ogale, who continued to develop his research program in composite materials and is initiating a new thrust in the area of stereolithography by collaborating with colleagues both in France and at Clemson in mechanical engineering and bioengineering. Another example is Professor Rice's research which has developed in new directions this year as well. He is involved in programs aimed at developing alternative automobile fuels, in collab-

oration with mechanical engineering, and in the area of the fundamental kinetics of nuclear fuel rod dissolution for disposal of spent fuel, in collaboration with colleagues in chemistry and ceramic engineering and at the University of South Carolina.

Research can play an important part in the everyday lives of South Carolinians. Of particular note is funding of a Federal Emergency Management Center (FEMA) project in civil engineering to develop a hazard mitigation program for low-rise buildings and other structures in South Carolina. This project, spearheaded by Drs. Ben L. Sill and Peter R. Sparks, will involve wind-load tests on low-rise structures, publication and distribution of design and construction guides to mitigate damage from wind, flood and earthquakes, and presentations of short courses and seminars to assist in implementation. A total of \$1.7 million over a five year period is expected, half of which will come from FEMA. The state and its citizens will save many times this amount when the next hurricane strikes South Carolina's coast.

Bearing the fruit of a research partnership, the Department of Environmental Systems Engineering initiated its agreement with Chemical Waste Management, Inc. (CWM) by constructing and occupying a 42,000 square foot research and educational facility located at the Clemson Research Park approximately eight miles from the main campus. This state-of-art research laboratory will enable the department to expand both its research activities and graduate student enrollments. Chemical Waste Management, Inc. plans to occupy a corporate research facility, presently under construction on a site immediately adjacent to the ESE facility, by February 1992. Although joint research initiatives with CWM already are under way, the full range of activities anticipated under the partnership agreement will be realized once CWM's move to the Clemson Research Park is completed.

In the research domain of industrial engineering, the level of sponsored activity also has increased significantly, almost doubling 1989-90 research expenditures. Included among this year's research projects were a study of factors affecting energy consumption in mobile homes, a municipal solid waste management study, and the development of educational programs for professionals who serve mentally disabled individuals, sponsored by governmental agencies; a frame scheduling study and a quality and process improvement study for optical consumer products, sponsored by industrial firms; and a manufacturing engineering project for young scholars, sponsored by the National Science Foundation.

Recent additions to the department's laboratories support our instructional and research missions. A flexible manufacturing cell is being developed to study quality and production related issues. The cell is based on a closed-loop conveyor system with four workstations. It is controlled by a token-ring network of 10 microcomputers. A vision system has been added to the cell for part recognition and inspection, non-contact sensing and gauging, and integration of quality and automation.

Public Service

Continuing Engineering Education (CEE) is a primary public service activity of the College of Engineering. In an era of increasing competition and technological change, participating engineers must continue their education to remain competitive. CEE provides a program of seminars, short courses and workshops designed to make the most effective use of the time that industry, government and consulting practice can allot to technical training. CEE also develops and sponsors conferences of one-day to one-week duration that promote technology transfer in a number of emerging technology areas.

During 1990-91 CEE offered programs in 12 different states. These programs included a three-day course on heating and air-conditioning controls design that was offered publicly in six states; a one-day course in new 530 Masonry Standards, offered at two South Carolina locations, a North Carolina site, a Florida site

and a site in Alabama; plus a series of programs on quality management in architectural and engineering firms, delivered in six states.

Major conferences were sponsored in the areas of advanced engineering fibers, environmental law and technology, plant engineering, and facilities maintenance and biomedical engineering. CEE also sponsored the annual S.C. Highway Conference in cooperation with the Civil Engineering Department.

The number of engineers attending various courses in the CEE Professional Engineering (PE) Review Series increased to a total attendance of just over 3,700. This series was offered in-house for Duke Power at Charlotte. The PE Review Series also was offered in Greenville, SC, in cooperation with the Piedmont Chapter of the S.C. Society for Professional Engineers. This year the series also was made available to those engineers who already had been registered for several years, but who wished to be updated on new developments in their fields.

In-house programs delivered for industry continued during 1990-91. A major event in the in-house area was the delivery of a three-day course in electrical/industrial power systems for three major companies: Duke Power, Carolina Power and Light, and Oglethorpe Corporation. Offered for the first time was a three-and-a-half day in-house "Statistical Process Control for the Food Industries" seminar in Virginia. Joint ventures and cooperative arrangements continued this year. CEE joined with the Greater Greenville Chamber of Commerce in sponsoring a conference on environmental law and technology, drawing 220 participants. Additionally, CEE joined with three technical associations in sponsoring the 530 Masonry Standards course. Furthermore, CEE and Textile Hall Corporation co-sponsored the International Fiber Producer Conference and Exhibition; the CEE conference was attended by 210 and the Textile Hall exhibition by 3,100. In addition to new programs described previously, CEE sponsored new offerings in reducing electrical energy costs, reducing energy usage in the '90s, statistical process control for food industries, solid waste landfill design, solid waste recycling systems, solid waste management, waste minimization in the printing and electroplating industries, and industrial safety.

On the departmental level, members of the mechanical engineering faculty have been active in the area of professional service at the state, national and international level. Dr. E.H. Law, appearing as the co-chairman of the ASME Task Force on Surface Transportation, testified before the Congressional Subcommittee on Technology and Competitiveness, presenting expert testimony on future transportation needs in the United States.

On the international level, Dr. J.G. Goree and Dr. P.F. Joseph have made extended research visits to the Soviet Union as a part of the formal exchange program between the Department of Mechanical Engineering and the Mechanical Engineering Research Institute of the Soviet Academy of Sciences. Dr. Goree also is serving on the U.S. Organizing Committee for the second U.S. - Soviet Union Symposium on Mechanics of Composite Materials.

College-Wide Programs

In the field of engineering development, more than \$2 million was pledged toward the planned Engineering Innovation Building during fiscal year 1990-91. At least \$3 million in private funding is sought, along with \$15 million from the state through a bond issue. Corporate commitments included \$1 million from Fluor Daniel, \$106,500 from NCR, \$100,000 from Union Camp and \$5,000 from Alumax. Frank Barnes ('42 EE), John Barnes ('45 EE), Edwin Barnes ('45 ME) and Ladson Barnes ('44 InEd) of Rock Hill Telephone Company committed \$250,000 toward a telecommunications laboratory in the new building, plus \$300,000 toward an endowed lecture series and \$300,000 toward endowed fellowships in telecommunications. Other individual commitments to the new building totaled nearly \$245,000, the largest of which is a gift of \$120,000 in floor coverings

from William Orders ('48 ME), president of Orders Distributing in Greenville, SC. Gerald Glenn ('64 CE), group president of Fluor Daniel, made a gift to the building of \$94,750.

The Engineering Innovation Building is a critically needed 100,000 square-foot facility to be under construction in 1992. The University's number one building priority, this facility will house laboratories, conference and seminar rooms, and offices for mechanical, electrical and computer engineering. Because of unparalleled growth in the college, the building is needed to help solve space shortages which threaten the quality of our programs.

One of the college's prize programs is the Minority Engineering Program, which was marked by a new program, student success, staff and program awards, new quarters, new staff, and double the corporate support of the previous year.

New Program: The Minority Engineering Program's main component, the Program for Engineering Enrichment and Retention (PEER), continued to strengthen its very effective peer-mentor network for underclassmen, as well as the industry/University partnership for upperclassmen, known as Pre-Professional PEER (P³). The Minority Engineering Program didn't stop with PEER and P³, however.

With the support of the Department of Energy and Westinghouse Corporation (Savannah River Site), we expanded its scope again by initiating the first Math Excellence Workshop (MEW).

National research of study habits shows that students who study in small groups perform better than those who study alone. Because research also shows that minority students tend to study alone, the MEW was implemented to encourage our minority freshmen to develop more successful study techniques early in their college program.

Student Success: A six-week program for incoming freshmen who took pre-calculus in summer school, the MEW challenged students with more difficult problems than they encountered in class. Under the direction of their professor, students worked in small groups to tackle the problems. The goal of this workshop was to teach students the benefits of group study.

And benefit, they did: 86 percent of the MEW participants earned As and Bs in pre-calculus. This contrasts with the 47 percent non-MEW participants who earned As and Bs. The students praised MEW highly, indicating their plans to form study groups for all their classes.

New Staff and New Quarters: Ms. Jill Williams-Wilks became the PEER Program Assistant in 1991. Her many years' experience with the Clemson Career Workshop equipped her well to work with students and Ms. Lasser in the PEER office. In the summer of 1991, PEER moved to its spacious new quarters in Riggs Hall, which will be home to the PEER Technical Library/Study Area as well. Mr. John Hopkins generously donated furniture for this space.

Corporate Support: Industry and business donations to the Minority Engineering Program in 1990-91 increased by 100 percent over 1989-90. Our corporate friends have made possible the successes described above. Their participation was recognized in April 1991 at the second annual Contributors Appreciation Dinner.

Faculty, Staff and Student Accomplishments

The faculty, staff and students of the College of Engineering continue to be recognized for their innovativeness and accomplishments in both the classroom and laboratories. Dr. Robert W. Snelsire, director of the Minority Engineering Program, was notified that the program was selected to receive a 1991 Retention Excellence Award from the Noel/Levitz Centers for Institutional Effectiveness and Innovation, Inc. Also, Susan J.S. Lasser, PEER Coordinator, received the "Faculty/Staff

Person of the Year" award from the Clemson University Chapter of the National Association for the Advancement of Colored People (NAACP). Lasser also completed qualification as a National Certified Counselor.

In Agricultural and Biological Engineering, Dr. David Brune was selected as the Outstanding Young Researcher for the American Society of Agricultural Engineers in 1990. Four students received departmental honors in ceramic engineering and two with perfect academic records intact — an outstanding achievement for a small department. One student received a competitive NSF Innovative Fellowship award and will be pursuing graduate work at Virginia Tech.

In civil engineering, three of our transportation engineering graduate students received federal highway administration fellowships to study in the Washington, DC, area. These fellowships are awarded on a competitive basis, and the receipt of three such fellowships is a tremendous honor and speaks well of Clemson. Through these fellowships, students receive financial support and obtain access to state-of-the-art research facilities which enable them to conduct research they could not possibly do in South Carolina.

In the Electrical and Computer Engineering Department, Lewis Fitch was honored by the Clemson University Chapter of the American Association of University Professors with its faculty award at the spring graduation. Prof. Fitch is one of the department's outstanding instructors, using innovative (and sometimes idiosyncratic) approaches to stimulate learning. Prof. Elham Makram won the Clemson University Alumni Research Award, and Prof. Chalmers Butler was awarded the College of Engineering's McQueen Quattlebaum Faculty Achievement Award. Prof. Adly Girgis was awarded the Professional Achievement Citation in Engineering by his alma mater, Iowa State University.

COLLEGE OF FOREST AND RECREATION RESOURCES

The report of 1990-91 activities for the College of Forest and Recreation Resources' academic, research and Extension programs is included under the Division of Agriculture and Natural Resources on page 113.

COLLEGE OF LIBERAL ARTS

The College of Liberal Arts continues to subscribe to the notion that no university will ever achieve greatness without a strong program in the humanities, performing arts and social sciences. In addition, the college continues to subscribe to the notion that a self-governing society requires of its citizens a basic and general education that will enable them, regardless of the career paths they follow, to lead full and thus useful lives, and to contribute to the general welfare of society.

To provide its alumni with timely information about the college and its activities, the college continues to publish its newsletter *Liberal Arts News*, which is edited by a member of the English faculty and is normally published twice yearly. The Department of English also publishes two newsletters of its own: the *Communications Across the Campus Newsletter* and the *English Department Newsletter*, both of which are desktop published on the premises.

While the undergraduate student population at Clemson rose 31 percent in the last decade, undergraduates majoring in the liberal arts rose 125 percent. The faculty of the college teach approximately one quarter of the credit hours taken by students; and, of the 38 semester hours needed to complete the University's "general

education requirement," the college contributes nearly all of the courses for 21 of these hours.

The College of Liberal Arts consists of the departments of English, History, Languages, Performing Arts, Philosophy and Religion, Political Science, Psychology and Sociology. Except for Performing Arts, all departments offer majors leading to the Bachelor of Arts degree. English and History offer the Master of Arts degree; Psychology offers the Master of Science degree in Applied Psychology; and both Sociology and Political Science will begin graduate programs in their departments in the fall 1991 semester. A graduate program in Professional Communication proposed by the Department of English has received campus approval and is being considered by the Commission on Higher Education.

More than 90 percent of the tenured and tenure-track Liberal Arts faculty hold the doctoral or other terminal degree. Graduates of the college enter some of the country's outstanding graduate and professional schools; many of the graduates pursue careers in business (including the service industries), industry and government upon earning their degrees from the University.

Faculty Highlights

Several highly respected journals emanate from the College of Liberal Arts. *The South Carolina Review* is edited and published by faculty members in the Department of English. This distinguished magazine, whose contributors have earned a number of awards, provides a forum for literary scholarship and criticism, as well as for outstanding poetry and short stories. The newest edition to the roster of college publications is *The Upstart Crow: A Shakespeare Journal*, which is distributed internationally and features scholarly articles from distinguished Shakespeareans on all aspects of Shakespeare: his life, the editing of the plays and poetry, dramatic and film productions of his plays, and the interpretation and teaching of his work. With an international editorial board under the leadership of a faculty member in the Department of Political Science, *The Journal of Political Science* boasts a list of authors from leading colleges and universities from this country and from overseas. This journal emphasizes the scholarly contributions of younger researchers and addresses contemporary themes, evidenced by an issue this year devoted to "The Ethnic-Nationalist Dimension in International Relations." The Department of Languages edits and publishes *The Comparatist*, which is devoted to the literary and language interests of scholars in the Southeast and which is the official publication of the Southern Comparative Literature Association.

Liberal Arts faculty also continue to be extremely active in scholarly and creative endeavors. They deliver papers at numerous regional, national and international meetings and conferences; they contribute articles, poetry and fiction to a variety of established and influential journals; they edit book-length collections and prepare textbooks; they are active in musical and dramatic performances; and they write books in their areas of expertise that are issued by respected publishers and that receive favorable notices in the press. For example, members of the History faculty published five books this year, while three additional History faculty members had book manuscripts accepted for publication.

The 1991 Alumni Master Teacher Award recipient was a member of the Political Science faculty.

In addition and as further acknowledgment of the recognition faculty members in the College of Liberal Arts are receiving, they often hold positions as officers and as board members of a number of professional organizations and societies. For example, a Political Science faculty member is chairman of the J. William Fulbright Foreign Scholarship Board. A Performing Arts faculty member continues to chair the Southeastern Theatre Conference New Play Project, while another faculty member in that department served on the National Selection Team for the American College Theatre Festival. The Selection Team chose the bill of productions for the national festival at the John F. Kennedy Center for the Performing Arts in Washing-

ton, D.C., from more than 800 participating productions. Too, the faculty serve on editorial boards in their areas, as manuscript referees for publishers, and as evaluators of grant proposals.

Other departmental activities include, but are not limited to, the following: a book review service originating in the Department of English that specializes in children's books; research conducted by the Department of Psychology in a variety of topics such as aging, industrial safety, stress management, computer-assisted instruction, artificial intelligence, consumer behavior, decision-making strategies, the development of pattern vision in children, eating disorders and substance abuse; and research conducted by faculty in the Department of Sociology encompassing several areas including police violence, parental grief, child abuse, children's responses to crises, alcohol consumption, abortion, homelessness and the sociology of emotions.

Regular features of the College of Liberal Arts include gatherings of scholars and creative writers. For example, this year the Department of English hosted the visit of Gwendolyn Brooks, a Pulitzer Prize-winning poet and one of America's most distinguished writers. She gave two public performances, both of which were very well-received by large audiences. The Department of Philosophy and Religion held a major conference on "Professional Ethics and Social Responsibility." The department also continued its speakers series by hosting five guest lecturers in philosophy. The Department of English continued to host the Southern Circuit Film Series which brought independent filmmakers to the campus to show and discuss their works.

Public Service

The public service roles played by the College of Liberal Arts throughout the state and region continue to experience significant growth. Political Science faculty are frequently called upon by units of state and local government for advice in such areas as poll-taking, taxation and government organization. In addition, political scientists often serve as panelists for civic organizations and as consultants to both the print and electronic media on national and international affairs.

Sociologists contribute their expertise in such areas as the design and analysis of social surveys, leadership, the impact of industrial development on society, as well as in program development and evaluation in the fields of prison reform, spouse abuse, child custody, mental health, and alcohol and drug problems. Faculty in Sociology also offer workshops in staff growth and development for both private and public service agencies. Psychologists continue to serve as consultants to the Southeastern Managers Network, an information sharing organization of senior managers representing more than 20 area businesses and industrial concerns. Psychologists also continue to provide consultation on jury selection, eyewitness validation and expert witnesses on criminal sanity. Graduate students in the applied psychology program provide a wide spectrum of services, including training, personnel selection, job analysis and labor-management relations to area industry and businesses. English faculty members conduct seminars and workshops in business and technical writing. One English faculty member was selected by the S.C. Arts Commission to be on the S.C. Readers Circuit for 1990-91.

In conjunction with its traditional language programs, the Department of Languages has sponsored since 1971 an annual Language Declamation Contest for high school students of modern and classical languages. This year's contest drew more than 600 participants from South Carolina and nearby states. In the summer of 1991, the department sponsored study abroad programs to France and Spain. The Department of Languages also recognizes that it has a special mission in a world becoming more internationalized with each passing year. Given the large foreign investment in S.C. industry and the need to develop overseas trade markets, the department's Language and International Trade major represents an apt response. An important component of this major is its required internship program.

This year 43 of the Language and International Trade majors completed internships; of these, 26 involved work experiences abroad, 11 in France, seven in Germany, and eight in Spain or Latin America.

Among the continued recipients of the college's public service activities are the state's schoolteachers. Improved civic education in the state's public schools is the goal of the Thurmond Seminar which is conducted by the Department of Political Science with funds from the Strom Thurmond Center for Government and Public Affairs. Twenty social science teachers from the state's secondary schools participated in this summer's seminar, with classes held both in Clemson and Washington, D.C. Liberal Arts faculty held summer institutes on campus for Advanced Placement (AP) teachers in Spanish and English.

Together with the College of Education, the Department of English sponsored the ninth Summer Institute of the Clemson Writing Project. The Bread Loaf Rural Writing Network, Middlebury College's Bread Loaf School of English and Clemson's Department of English continue their partnership in administering grants to teachers and students in several public schools in the state. Piloted by the Bread Loaf Rural Writing Network in South Carolina, Project REACH (Rural Education Alliance for Collaborative Humanities), which is funded by a Rockefeller Foundation grant channeled through the S.C. Humanities Council, operates out of a base in the Department of English.

The Bingham Trust awarded one of the largest grants in the college's history to fund two programs, Writing in the Schools and Performing Across Cultures, which are collaborative ventures between the University and the secondary schools to improve writing and to foster cultural awareness. Additional outreach activities include faculty from the Department of Performing Arts serving regularly as judges for competitions in such areas as music and theatre in the region and state. In addition, "Theatre for Young Audiences," a touring theatre company made up of University students and faculty, along with townspeople, under the direction of a Speech faculty member, presented 25 performances in the public schools of Pickens, Oconee, Anderson and Greenville counties. Also, the Music Preparatory Program of the Department of Performing Arts expanded this past year to include music therapy as an offering in addition to Kindermusik and Suzuki instruction.

The College of Liberal Arts serves the entire student body in a variety of ways other than through direct classroom instruction. For example, the Model United Nations Program, which is sponsored by the Department of Political Science, annually competes in and has won awards at national conferences at Georgetown and Harvard Universities, and at the National Model United Nations in New York City. Political Science also sponsors the State Student Legislature and the government internship program, the former involving an annual competition in Columbia and the latter involving students participating in local, state and national government. The Department of English operates the Writing Laboratory, which is available at no charge to all students on campus with writing deficiencies.

The college also contributes to University life by supporting a number of student organizations and extracurricular activities. For example, Performing Arts oversees the Clemson Players, the student drama group that stages four plays during the academic year and two during summer school. Some of its productions have received regional and national recognition. Many musical activities also are under the direction of Performing Arts: the University Concert Series, Robert and Lillian Utsey Chamber Music Series, and student organizations including Tiger Band, Symphonic Band, C.U. Chamber Orchestra, University Chorus, Chamber Singers, C.U. After Six Singers, and Jazz Ensemble. The Department of English provides faculty advisors for two student publications: *The Chronicle* and *The Tiger*, the weekly student newspaper that has earned a number of collegiate awards.

Program Development

The R. Roy and Margery W. Pearce Center for Professional Communication co-sponsored many activities in the Department of English, including the Bard College Writing Program, which was made possible by a grant from the Bingham Trust, as well as the Career Workshop program for minority students.

The College of Liberal Arts Advisement Center, which began operations in the summer of 1988, has as its principal activity the academic advisement of nearly 300 undergraduates enrolled as Liberal Arts (Undeclared) majors, a category designed for students who have not yet decided on a major area of study and are in the process of exploring academic options.

In conjunction with its freshman English program, the Department of English brings to campus each year a notable writer. This year Trudier Harris, a well-known Black scholar from the University of North Carolina at Chapel Hill, addressed the freshman class on their common topic in composition classes, Alice Walker's *The Color Purple*.

The Language and International Trade undergraduate major represents one of the significant bridges erected by the College of Liberal Arts to span the gap between the liberal arts and the scientific and technological disciplines on campus. This major joins Liberal Arts with the colleges of Agricultural Sciences, Commerce and Industry, and Forest and Recreation Resources in a most successful interdisciplinary effort.

Another continuing and successful interdisciplinary endeavor, Communication Across the Curriculum, which is housed in the departments of English and Performing Arts, involves all nine academic colleges in the communal goal of improving the writing skills of students.

The Department of Psychology's Master of Science degree in Applied Psychology with tracks in both human factors and industrial/organizational psychology has completed a very successful third year. Its graduates are in demand by both regional and national companies.

The groundbreaking ceremony for The Robert Howell Brooks Center for the Performing Arts took place on April 5, 1991. Significant progress is being made on the remodeling of Brackett Hall which will house the social science departments of Political Science, Psychology and Sociology.

COLLEGE OF NURSING

The College of Nursing has demonstrated continued growth in its academic, professional service and research programs during the 1990-91 academic year. Significant impact on the broader community and the citizens of South Carolina has been made through the production of graduate nurses at the beginning professional practice level as well as the advanced practice level, and through the provision of a variety of research and health service programs. The college has been reorganized through the creation of two additional departments to more effectively fulfill its mission. Significant support for college programs is being derived from overall college development activities.

Administration

Dr. Opal Hipps, dean, provided leadership for the organizational changes designed to facilitate achievement of the college mission. Academic programs leading to the Bachelor of Science and the Master of Science in nursing are administered by Dr. Robbie Hughes, head of the Department of Instruction. A new Department of Health Science was created and approved by the Board of Trustees to administer the

growing offerings in health, which include electives and a minor option. Dr. Debra Broadwell-Jackson serves as acting head of the Department of Health Science. The name of the Department of (Nursing) Instruction has been changed (Board of Trustees, July 1991) to the Department of Nursing Science in light of two "instructional" departments in the college.

Dr. Larry O'Neal assumed the position of head of the Department of Continuing Education in November 1990. Dr. Sara Barger resigned as head of the Department of Professional Services effective June 21, 1990. Dr. Pam Kline assumed responsibility for this department in August 1991. Dr. Mary de Chesnay continues as head of the Department of Research.

College development, under the direction of Pat Padgett, has demonstrated substantial growth during the past year. Fourteen proposals were submitted to individual corporations or foundations detailing opportunities for support of college programs. The College Development Board expanded with the addition of two new members, Mr. Ed Mitchell and Mr. Buzz Benson. The college's endowed scholarship program increased by \$51,192 and the annual scholarship program increased by \$17,084 for a total in annual scholarships of \$36,173 in 1990-91. Current gifts totaled \$4,750 in equipment, while the planned gifts totaled \$210,000. Three issues of *Recent Developments*, the college newsletter, were published and circulated to faculty, students, alumni and friends.

Teaching

In the Department of Instruction, courses were offered for nursing majors in both the baccalaureate and master's programs. A total of 59 students graduated from the undergraduate and graduate programs during 1990-91. Student enrollment during the past year included 314 undergraduate students and 73 graduate students.

Recruitment efforts have continued with excellent results. Anticipated enrollment of freshmen and transfer students for fall 1991 is approximately 122, a 20 percent increase over the 95 who enrolled in fall 1990, a significant achievement in view of declining freshmen enrollments nationwide. New graduate student enrollment for fall 1990 was 26, with total graduate student enrollment of 73.

Recruitment of minority students, including males, continues to be emphasized along with recruitment of traditional students in an intensified effort to meet the demand for more professional nurses. As a result of these efforts, enrollment of minority students has risen steadily in the college. In 1988 minority enrollment was 2 percent of the graduate program and 3 percent of the undergraduate program. In 1989 these figures rose to 5 percent for graduate students and 9 percent for undergraduate students. In fall 1990 minority enrollment was 8 percent for graduate students and 18 percent for undergraduate students.

"Heart of Health" Summer Nursing Career Camp, supported by funds from Baptist Medical Center in Easley and the Office of Human Resources, was held for the ninth year during June. Under the direction of Beth Hearn, director of Nursing Enrollment, and faculty member Portia Botchway, 39 junior and senior high school students, including 14 minority students and one male, spent a week involved in activities to acquaint them with college life and nursing career opportunities.

The RN/BS/MS program of study which was approved last year has been received positively in the community. This program allows registered nurses with an associate degree to enter Clemson as transfer students, with credit given for general education and support courses taken at any institution approved for transfer credit by the University. In its first year approximately 200 registered nurses have received individualized advisement and have begun preliminary course work leading to the bachelor's degree. These students will complete general education and support course requirements at area community colleges prior to enrolling for their final year of study at Clemson. Anticipated enrollment for registered nurses for fall 1991 is projected to be 20, an increase from the four who were enrolled during the spring of 1991.

Accreditation for nursing education programs is highly valued. After a rigorous two-year self-study, culminating in a site visit by accreditation visitors, the College of Nursing received National League for Nursing reaccreditation for both the baccalaureate and the master's program for the next eight years, the maximum allowed. Full approval by the State Board of Nursing of South Carolina for the bachelor's program also was granted after a site visit by the program consultant in conjunction with the NLN visit. State Board approval was given for three years, the maximum allowed by that agency.

The College of Nursing had its second international study abroad program during summer school 1991. Three graduate students and one undergraduate student spent one month in the Netherlands studying health care and health policy. They were accompanied by Ms. Jeri Milstead, assistant professor. During the same period two Dutch nursing students came to South Carolina to enroll in Nursing 485, Nursing Extern Practicum, a senior clinical elective course offered in cooperation with the Greenville Hospital System. Students who traveled to the Netherlands stayed in the dormitory of St. Elizabeth's Hospital in Leiden, the host agency which also sponsored the Dutch students who came to Clemson. Dutch students stayed with a nursing administrator employed by the Greenville Hospital System.

In addition to the student exchange, four nurses along with an attorney visited Clemson during the past year, exploring differences in health care delivery from the Dutch perspective. They met with nursing leaders throughout the state during their visit, exchanging ideas and discussing common interests and visions for the future.

An exchange to foster developments in nursing education and health care between Australia and the United States was initiated in the spring with the college hosting two nurses from Australia for 10 days. Two faculty also participated in a two-day symposium with 24 Australian nurses at Lander College which culminated the visit to the United States.

The creation of the Department of Health Sciences was the result of the increased activity in health courses which reflects the growing public interest in health information and health consumerism.

A total of 813 students enrolled in health courses during the past year, an increase over the 699 who enrolled during 1989-90. A proposal for an undergraduate major in health science is currently under consideration by the Commission on Higher Education, with approval anticipated in November 1991 for implementation spring 1992 if approval is obtained.

Overall faculty development and productivity in research, publications, scholarly presentations and academic preparation continues to demonstrate progress. Since 1989 the percent of tenure track faculty holding terminal degrees has risen from 44 percent to 74 percent, with an additional 10 percent currently enrolled in doctoral study.

The College of Nursing served as a site for implementation of the federally funded project, Faculty Preparation for Teaching Gerontological Nursing, sponsored by the Southern Regional Education Board. Dr. Pam Kline, site coordinator, and Dr. Ann Wetsel, faculty, conducted a week-long course designed to improve nursing faculty's knowledge and abilities to teach today's students how to care for the aging population. Faculty attendees were from both Carolinas and Arkansas.

Research

Research grant activity during 1990-91 has totaled \$129,800 which included one new extramural grant awarded from NIH and 10 intramural research grants awarded to 12 faculty members. These included two University Research Grants Committee awards, one Biomedical Research Support Grant, two Provost Awards, four special Provost Awards, and the E.M. Baines Award. Four extramural proposals have been submitted to NIH and the Andrus Foundation.

Six faculty have had 11 papers accepted and/or published in reference journals. Two faculty, B. Baines and S. Thompson, have published textbooks and several

faculty members are involved in writing book chapters. Thirteen faculty have made a total of 26 scholarly presentations at national and international meetings.

Three faculty are involved as principal investigators in interdisciplinary initiatives under the Clemson University/Greenville Hospital System cooperative research agreement. Dr. Mary de Chesnay, head of the Department of Research, serves as facilitator to the three projects.

An international research initiative was begun involving three faculty in Dominica through the Archbold Tropical Center. An initial visit to explore opportunities resulted in funding of one research proposal and a second proposal in preparation.

One Governor's School student participated in the Research Mentorship Program with Dr. de Chesnay.

Service

The Department of Professional Services comprises three programs that provide specific nursing, health and educational services to the public: The Nursing Center, the Wellness Center and Community Nursing Services. They also provide educational and research opportunities for students and faculty.

Increasing the public's access to needed health services became a major focus for the Nursing Center during the 1990-91 fiscal year. In October 1990, through a cooperative agreement with the governor's office, the department was loaned a fully equipped mobile clinic to take its health services out to the community. Five members of the department completed a training program to drive the 30 foot mobile clinic. The mobile clinic provides certification and food vouchers for women, infants and children under the Women, Infants and Children Supplemental Food Program (WIC). Also provided are immunizations and Early, Periodic Screening, Diagnosis and Treatment (EPSDT) services where health screenings are provided for Medicaid eligible children. The town of Westminster receives services from the mobile clinic twice a month under a contract with Appalachia Health District I. Other sites for mobile clinic services include the Creekwood Housing Project in Central and a community coalition meeting in Greenville. In another effort to increase access to needed health services, the Nursing Center began offering family planning services in January under a contract with Appalachia Health District II. Access to care also was increased for Medicaid clients. The two nurse practitioners in the center received provider numbers to enable them to see Medicaid clients and be reimbursed for their services. These two practitioners were only the second and third nurses to receive these numbers in South Carolina.

Individual clients made a total of 5,208 visits for Nursing Center services during the 1990-91 fiscal year compared with 5,006 in 1989-90. Of these, 1,512 were made to other sites more convenient to the specific client population, including high schools, colleges, senior citizen centers and area industries.

The Nursing Center provides a wide array of services for economically and culturally diverse populations. These include the WIC program, EPSDT screenings, asbestos-removal workers' physical exams, family planning services, flu shots, immunizations, child developmental assessments, and physical exams.

The Wellness Center continues to expand services on and off campus. Early in the fall semester a letter was sent to each dean on campus offering to bring wellness screening services to his building. Deans of five colleges took advantage of this offer, and services were provided in their buildings. To inform people about the Wellness Center and to provide them with information about healthy lifestyles, 26 presentations were made to 1,305 people on and off campus.

A major wellness event on campus sponsored by members of PATH (Planned Approach to Health) was the "Ready, Set, Go, Fitness Classic" for all 1,200 fourth graders in Pickens County. This was the largest youth fitness event ever held in South Carolina. Evaluations by school district personnel, students and representatives of the President's Fitness Council were so outstanding that plans are under way to repeat the event next year.

The fifth annual "Wellness Challenge" to encourage regular aerobic physical activity in students and employees was held in the spring. Of the 202 participants enrolled in the program, 120 obtained both pre and post exercise program measurements which demonstrate improvement. This compares with 240 participants enrolled in the 1989 Challenge. With five years of "Wellness Challenge" data, efforts are under way to examine the data longitudinally to determine trends.

The "Slim Down Challenge" continued to be a popular program on and off campus. Fall semester, 275 people, including 25 teams from Duke Power, participated and lost 483 pounds. In addition, health screenings were conducted off campus at Ryobi, Mauldin, 3M, Central Wesleyan College, McDuffie High School and the Greenville Urban League.

Community Nursing Services is a home health program offering intermittent skilled nursing care, home health aide services, speech therapy, occupational therapy and social work services to home bound individuals within a 12-mile radius of Clemson University. These services are provided under a physician's order to clients in their homes.

Community Nursing Services was licensed as a home health agency in February 1990, and its license was renewed in February 1991. Community Nursing Services continues to be certified to receive third-party reimbursement.

During the 1991 fiscal year 10 home-bound patients received 176 skilled nursing visits in their homes. Services are provided by four faculty members who rotate coverage in order for the service to be available 24 hours a day, seven days a week. In addition to skilled nursing services, those of a social worker, speech therapist, occupational therapist and home health aide are available through contract.

The Department of Continuing Education has provided 31 conferences for 1,039 nurses and other health professionals from 47 different states in a wide range of subjects. This compares with 34 conferences in 1989-90.

The service programs of the College of Nursing have gained a national reputation for extending the scope of nursing academe in new arenas of health care delivery. The college has been innovative in developing its model to integrate teaching, research and service. Now additional creativity will be needed in this era of resource scarcity to finance its future development.

Outstanding Faculty Accomplishments

- Dr. E. Juanita Lee, director of the Nursing Center and assistant head of the Department of Professional Services, was inducted as a Fellow of the American Academy of Nursing at the academy's annual meeting in Charleston. She is the second college faculty member to receive this distinctive honor.
- Dr. Opal S. Hipps, dean and professor, was elected chair-elect of the National League for Nursing's Council of Baccalaureate and Higher Degree Programs. She has been serving on the council's executive committee and also has served as a program accreditation site visitor. In addition, in April 1991 she was selected to serve on the Educational Excellence Team for Curriculum/Health-Physical Education.
- Jeri Milstead, assistant professor, was honored by the State Board of Nursing for completion of a four-year term on the Board (1986-90) and her contributions as president (1988-89).
- Dr. MaryAnn Reichenbach was appointed to serve on the State Board of Nursing to fill the Registered Nurse vacancy in the 3rd Congressional District.
- Dr. Debra Broadwell-Jackson was awarded an AREA research grant of \$112,281 from NIH for her study on "Study Variables Affecting Ostomy Patient Outcomes."
- Mary Reimer, director of the Media Resource Center, was accepted into the Medical Library Association of Academy of Health Information Pro-

professionals at the senior level for a five-year certified period. The academy recognizes members as certified medical librarians to insure high standards of professional competency and achievement in the field of health information management.

COLLEGE OF SCIENCES

Research programs in the College of Sciences continued to increase at an annual funding rate of about 20 percent. Several prestigious national meetings and international science workshops were held on campus. Aggressive development continued in a number of specific research areas identified in the University's strategic plan, such as biotechnology, astrophysics, materials science and instructional technology. The partnership between the Westinghouse Savannah River Site and the S.C. Universities Research and Educational Foundation (SCUREF) has allowed the College of Sciences to collaborate with other colleges in undertaking challenging new initiatives in ecology, toxic waste management and ground-water geology. An affiliation with the Greenville Hospital System now is in place and promises exciting opportunities for greatly expanded basic and applied research in biological sciences.

Clemson University, the first remote site to be chosen by the Educational Testing Service for expansion of its programs, was once again host to the Advanced Placement Readings run by ETS. Two chief readers and the director of the reading are College of Sciences faculty members.

The Department of Earth Sciences has attracted five students to its new master's degree program. The Geology Museum continues to develop and has become one of the campus attractions.

Dean Bobby G. Wixson has served as chairman of the Society for Geochemistry and Health (SEGH) Task Force to develop recommended guidelines for lead in soils. This internationally recognized committee report has received external review and is in the final stages for publication in early 1992. In addition, meetings were held with British representatives to explore the possibility of their joining the Clemson University consortium utilizing the facilities of the Springfield Plantation Field Station in Dominica.

Dean Wixson also was reelected as secretary-treasurer of the U.S. Foundation for International Economic Policy and continues to serve as chairman of the U.S. University Advisory Committee (representing 104 U.S. universities) concerned with the establishment of U.S. branch campuses in Japan with full accreditation for courses taught in and transferred. Dr. Wixson was elected as a Fellow of the Strom Thurmond Institute of Government and Public Affairs.

In June Dr. Wixson joined a Clemson delegation that traveled to the Far East to meet with the Hong Kong University of Science and Technology (HKUST) at their invitation. A visit was made to their new campus where possible faculty, student exchanges and cooperative research programs were discussed. Appropriate industry leaders also were contacted and plans have been made for a university-industry meeting on the U.S. west coast in spring 1992 to develop action plans and schedules. The dean of sciences at HKUST will visit Clemson facilities and faculty this fall to propose areas of interest to be used in the 1992 action plan.

In the realm of teaching, our faculty are meeting the requests for additional exposure to material with optional tutoring sessions and computer assisted laboratories. New courses are being developed in all departments to reflect the changes in technology and focus. Calculus, statistics and linear algebra are being taught using "smart" calculators.

Department of Biological Sciences

Society's greatest concerns as it prepares for the 21st century are to preserve the environment and to provide for the health of its citizens. Biology plays the central, and most important, role in each of these areas. Our department's goal is to prepare our undergraduates to actively participate in making the hard decisions that will be necessary. This involves not only "the facts," but the ability to use these facts and integrate them with new information and ideas. This central concern with biology is reflected in our rising undergraduate enrollment; now 422, more than double five years ago and triple eight years ago. To prepare these students we have completely revised our course offerings to emphasize the basic themes common to all organisms, plant and animal. This is in contrast to the prior emphasis on subdivisions within the animal and plant kingdoms. These changes are being integrated into a coherent curriculum for both our majors, biochemistry and biological sciences.

We also are preparing our graduate students to meet the research needs of the 21st century. To accomplish this we have reorganized our research laboratories and faculty. This has involved bringing researchers with divergent backgrounds into physical proximity to nurture new interactions. It also has involved creating new laboratory space for programs to expand and grow.

Our faculty are being called upon to maintain an active teaching program consistent with our goals in undergraduate education, to teach at the graduate level and to maintain an active research program. They have responded to these challenges with new energy and enthusiasm. In the face of an increase in the total number of students taught we have increased our total research funding to an all-time high of \$3.6 million of committed funds for 35 projects. We are optimistic that this will continue to rise, as we have 37 pending proposals totaling more than \$10 million.

To provide the graduate instruction and facilities essential to our mission will require commitment of new resources. In spite of tight budgets we have hired one new faculty member to augment our programs in cell and molecular biology and are in position to hire a second in the area of ecology.

As graduate instruction and research becomes more interdisciplinary it has become necessary to reach beyond our department to form alliances with others on campus. We are in the process of developing and presenting to the CHE a new graduate degree program in genetics which will involve several departments in the College of Agricultural Sciences, as well as the departments of Microbiology and Biological Sciences in the College of Sciences. In addition, we are in the beginning stages of developing a program in plant sciences which will span the College of Sciences, the College of Agricultural Sciences and the College of Forest and Recreation Resources. We already are committed to a common program of recruiting graduate students in the plant sciences.

In addition to partners in other colleges and departments we have expanded through partnerships with local hospitals and clinics. Under our guidance, and in collaboration with the Department of Bioengineering in the College of Engineering, the University has signed an agreement with the Greenville Hospital System committing \$10 million over a five-year period to develop a program of biomedical research. This will include seven new faculty and a new research building on campus. As part of this agreement we already have on board one new researcher from the Greenville system with more to come. In addition, we have reached an agreement with the Greenwood Genetics Center to support additional graduate students and to participate in hiring of new faculty.

Biology Program

During the 1990-91 academic year, approximately 5,800 students were enrolled in courses in the Biology Program. Eleven lecture sections and 87 laboratory sections per week were taught each semester by faculty and graduate students from the

Biology Program and departments of Microbiology and Biological Sciences.

Two faculty members conducted a workshop reunion at the annual meeting of The Association for Biology Laboratory Education in the teaching of investigative laboratories which was attended by 30 biologists from throughout the United States and Canada. The Twelfth Annual Clemson University Biology Merit Exam was conducted in April. Approximately 1,900 students and teachers attended. One faculty member has been selected by Benjamin/Cummings Publishers as author of a laboratory manual to accompany a nationally marketed textbook.

Several grants were awarded to faculty of the Biology Program during the 1990-91 academic year. These included a continuation of a \$60,000 Undergraduate Faculty Enhancement Grant from the National Science Foundation, two grants totaling \$45,000 to develop materials for the Center of Excellence in Science and Mathematics, a \$200,000 Eisenhower Grant for the training of middle school science teachers, and a \$56,000 renewal of a grant from the U.S. Department of Education Fund for the Improvement of Post Secondary Education. Ten grant proposals were submitted by the faculty; six were funded.

Scholarly activities carried on by the faculty included five published manuscripts, four nationally published laboratory manuals, authoring of six instructor's manuals, and the development of 65 computer-based and videotape instructional materials. Twelve papers were presented by faculty at national and regional meetings including the annual meetings of the National Association of Biology Teachers, National Science Teachers Association, the American Association for the Advancement of Science and the Association for Biology Laboratory Education. One faculty member continues to serve as chief reader for the Advanced Placement Program with the Educational Testing Service and taught eight national biology advanced placement workshops. Faculty also continue to serve as reviewers for the National Science Foundation and various publishers of biology textbooks and laboratory manuals.

Department of Chemistry

The Department of Chemistry continues to be responsive to needs in all areas: undergraduate and graduate teaching, basic and applied chemical research, and service to the community and state.

The general chemistry program has continued to grow and has now reached more than 3,500 students per year. Changes in the laboratory and the continued upgrade of computer-assisted instruction in the Chemistry Help Center are increasing the success rate and attracting more students into chemistry and chemical related sciences. This past year the academic programs received a lot of positive input from students.

Faculty and staff changes include:

- Dr. John D. Beckerle joined the faculty as an assistant professor of physical chemistry. Dr. Beckerle received his Ph.D. at M.I.T. and was an NRC postdoctoral fellow at National Institute of Standards and Technology before coming to Clemson.
- Dr. Graham B. Jones joined the faculty as an assistant professor of organic chemistry. Dr. Jones was trained in Great Britain and comes to us following a NATO postdoctoral fellowship at Harvard University with Nobel laureate Professor E. J. Corey.
- Dr. Muriel B. Bishop retired after 32 years of service. She continues to work on a writing project and as an associate editor for the *Journal of Chemical Education*.
- Dr. James C. Fanning spent the fall of 1990 on sabbatical leave at the University of North Carolina, Chapel Hill.
- Dr. Rudolph A. Abramovitch spent the spring of 1991 on sabbatical leave at the Universitat Autònoma de Barcelona in Barcelona, Spain.

- Ms. Ellen Few and Ms. Stacy Murray joined the department as word processing specialists.

In research, the department continues to publish more than 100 scientific research articles per year and expend close to \$1 million in externally generated research funds. Patents obtained by Drs. DesMarteau and Marcus could result in financial gain for the department and the University.

Many of our younger faculty are gaining international reputations in their areas of expertise. Dr. Kholodenko was invited to present a lecture tour in the U.S.S.R. Drs. Kolis, Marcus and Robinson all had invitations to talk at meetings in this country and Canada. In addition, more established research groups in the department seem to flourish, such as Dr. DesMarteau (Tobey-Beaudrot Professor) who generates almost \$500,000 in research funds per year and Dr. Abramovitch who secured a new NSF grant.

The summer undergraduate research program (SURP), which was organized by Dr. Parsons and funded by NSF and other agencies, brought 18 undergraduate students to Clemson this summer from all over the country. These students worked in various research labs, did good work, were excited and are good prospects for returning to Clemson as graduate students upon graduation.

Dr. Fanning ran a summer program for high school teachers in industrial chemistry. This program, funded by the state, involved visiting 13 plant sites in South Carolina where they met with industrial leaders. The program was very successful for the teachers and the industrial sponsors.

Dr. Cooper began to implement the cooperative learning concept in the freshman laboratories. This enables students (even freshmen) to do experimental chemistry more like it is done in a research laboratory and less as a "cook-book" approach. The NSF is very interested in our progress in this area.

Over the next few years, this department will see six to nine faculty retire. These next few years will be critical in the long-term development of the department, and the faculty, staff and students are looking forward to this challenge with eager anticipation.

Department of Computer Science

The Department of Computer Science had another good year in 1990-91. The instructional programs were strengthened and research productivity increased.

The number of undergraduate majors remained at about 300 in the department's two B.S. programs. There were 52 B.S. graduates during the year, 17 in computer information systems and 35 in computer science. This is the same number of B.S. graduates that the department produced last year, and it reflects a leveling off after a steady decline in the number of majors that occurred nationally between 1982 and 1987.

The number of graduate students was down slightly from 110 in 1989-90 to 102 in 1990-91. However, this appears to be a temporary decline and the number is expected to increase in 1991-92. There were 19 M.S. graduates during the year, down from 30 in the previous year, and no Ph.D. degrees in computer science were awarded. The number of graduates in both programs should increase in 1991-92.

Employment prospects continue to be excellent for our graduates. The demand for graduates appeared to hold up well, although there was some decline due to the downturn in the economy. Starting salaries were higher.

Externally funded research remains at about \$1 million in annual expenditures. Good progress is being made in diversifying and expanding the research funding base. The department also continues to be quite successful in attracting equipment donations to support research and instruction. Maintenance on our equipment continues to be a problem, however, because the operating budget allocation for the department is only half of the normal expenditures. The remainder is generated by the faculty through research funding, but having to pay normal operating costs from re-

search incentive funds inhibits the use of those funds to enhance the research productivity of the department.

Space continues to be a major problem for the department. The renovation of new space in Jordan Hall has been a great help, but permanent office and laboratory space for the department must be found to provide a reasonable "home" for the department. The temporary quarters in the Nursing Building have served the department well during its development, but there is not enough space in the building for both the department and the College of Nursing, and the building was not constructed with the needs of the department in mind. All available space is now filled, and the department is now in the position of having no space available in which to put donated equipment or externally funded research projects. NSF support for a new instructional laboratory for 1992-93 has been obtained, but the department has no space in which to put it.

Our enviable record of faculty retention remains in danger as our faculty find that they can easily find jobs at peer institutions at a significant increase in salary. Some progress was made in improving salaries the past few years as a result of the University's salary adjustment efforts, but the lack of any raises in 1991-92 will represent a significant step backward.

A third problem area is in the recruiting of high quality graduate students. We are again unable to compete with the support levels that are offered by our peer institutions. An increase in assistantship stipends and the establishment of substantial fellowships are greatly needed.

Department of Earth Sciences

A significant milestone was reached this fall when the graduate program in geology got under way. The new graduate program emphasizes ground-water geology and is designed to meet a pressing demand for qualified hydrogeologists. This interdisciplinary program involves faculty from the Department of Earth Sciences and the College of Engineering.

The Department of Earth Sciences received a \$50,000 gift from Bob and Betsy Campbell to enhance the master's program in ground-water geology. This gift has been used to purchase equipment for a field laboratory for research and education. The project takes advantage of an ideal well field laboratory situated at the Savannah River Site (SRS) on the Coastal Plain near Aiken. Data obtained from this well field are being processed by researchers and graduate students in the departmental ground-water modeling laboratory, recently enhanced by the gift of a RISC 6000 computer system from IBM. The goal is to develop a nationally acclaimed field training program in ground-water geology.

The self-study and assessment of the Earth Sciences Department were implemented during the past year. The major mission of the department was identified as being the training of students in the fundamentals of geology, both theoretical and practical, leading to the bachelor's and master's degrees. An important auxiliary is the teaching of introductory geology courses to Clemson undergraduates majoring in other disciplines. Expanding and improving research productivity, training and recertifying S.C. earth science teachers in K-12 grades, and augmenting the public service role of the department also were identified as important components of the department's mission.

As the Department of Earth Sciences moves to strengthen its existing baccalaureate programs and new graduate program, several challenges must be faced. One is the need for a permanent department head to lead and expand the graduate program in ground-water and enhance the quality of the undergraduate program. Improved equipment is a continuing need, especially as the earth sciences programs prepare to relocate into the newly renovated Brackett Hall.

Additional office staff is badly needed at the present time to support the widened commitments of earth sciences. More and larger graduate student stipends will attract a larger number of the best candidates to the geohydrology graduate program.

Finally, the department's operating budget must increase substantially to cover additional costs in travel, supplies, equipment maintenance and related needs.

Noteworthy among individual accomplishments during 1990-91 was the award of a SCUREF research grant to Dr. David Snipes (\$1.6 million over five years from Westinghouse Savannah River Company/Department of Energy to establish and study the ground-water well field at the Savannah River Site). Dr. Richard Warner received a \$30,000 grant from the National Science Foundation for a two-year study of lower crustal rocks, and John Wagner was co-investigator on a \$143,748 CHE funded project to train earth science teachers. Other faculty remained active in geologic research and teaching. Finally, under the guidance of Mrs. Betty Newton, the Geology Museum in Brackett Hall has emerged as a major campus attraction, which during 1990-91 drew more than 5,000 visitors.

Department of Mathematical Sciences

The Department of Mathematical Sciences continued its strong commitment to teaching, not only by continuing to offer nearly one-eighth of the total credit hour production of the University, but by innovative new classroom techniques and formats. The department awarded 25 bachelor's degrees, 17 master's degrees and two Ph.D. degrees during the 12-month period; the Ph.D. production was down due to a backlog of nearly finished students. The faculty maintained and indeed increased its national and international stature for scholarly endeavors while at the same time serving professional organizations and the University in a myriad of ways.

Our innovative teaching of calculus, statistics and linear algebra using "smart" calculators and micro computers drew the attention of the national mathematical community. A publication by the Mathematical Association of America, "Priming the Calculus Pump," featured 10 calculus enhancement projects from around the country which are viewed as having been particularly successful. Our project, partially funded by the Federal Department of Education, is the first program featured. We recently have received word that the NSF is going to fund the next phase of our program, a joint effort with Georgia Tech.

Our graduate programs continue to be among the most successful in the United States. These master's and Ph.D programs draw students from all over the country, and they are among the very best the nation has to offer; we now have approximately equal numbers of Ph.D. and master's students. Evidence of the national attention being drawn to the programs was given in November of 1990. We were visited by a special committee from the Board on the Mathematical Sciences, the mathematical board for the National Research Council/National Academy of Sciences. The board appointed the committee to select and visit 10 Ph.D. programs which have been particularly successful and then to write a report to be nationally circulated, describing these essential elements of success so that others may emulate them. When our faculty travel, the visit often is mentioned to them so that the "word" is spreading even though the report to be issued later this year will not specifically name the visited schools.

The department's commitment to teaching and teachers was evidenced by our continued strong involvement in mathematics education. Through our various state and national grants and contracts we have worked with mathematics teachers throughout the state; several new proposals have been written and preliminary information is that some very large ones are going to be funded. One of our faculty members was the principal participant in a \$1 million project for creating video tapes for classroom use, a grant to the Mathematical Association of America. Another had a SCUREF project for creating such tapes for elementary and secondary classes.

We have been given an excellent opportunity to bring our strong interests in the teaching of mathematics together with graduate programs and research. We were selected by a committee which is serving all three national mathematics organizations to be one of four national pilot projects to put a new emphasis on the teaching of

mathematics as a regular part of the mathematics Ph.D. program. The project is funded by the U.S. Department of Education. In our case, we are offering a course for post-exams Ph.D. students, all of whom have some teaching experience, wherein pedagogy will be mixed with student presentation of new mathematical topics and discussions will center on how to be better classroom teachers. There will be reviews of college level mathematics teaching materials and discussions of what makes effective teaching. The key here is this is NOT teaching assistant training, but in depth discussion of professorial level teaching and is a course in the regular Ph.D. program

The research activity of this department continues to be first rate. Collectively, we published in excess of 50 research papers in professional journals, had about 50 accepted for publication, another 50 or so submitted for future publication and gave numerous presentations at professional meetings. We had several newly funded research projects each of which had a particularly significant element. For the first time in several years, one of our young faculty members received an NSF basic research grant; these grants are the most competitive among all the funding in the mathematical sciences. Two senior researchers were awarded a basic research grant from the relatively new National Security Agency Mathematics Research Program, quite an accomplishment because the competition is especially keen. Three of our faculty members were awarded a grant by the Savannah River Project to study ground-water pollution. This timely project not only provides research support but will put our faculty and graduate students at the forefront of one of the most important problems facing this country. Some of our continuing research funding also is out of the ordinary. Among other things, we have faculty in the midst of studying fire retardation for the National Institute of Standards and Technology, faculty working on projects with two different private corporations, as well as a \$500,000 NSF project working with Pickens County teachers.

Our continuing "Distinguished Rotating Professor" series brought 10 of the world's leading statisticians to campus this spring, including Ingram Olkin from Stanford University, Herman Chernoff of Harvard University, Richard Barlow of UC, Berkeley and David Scott of Rice University. This series has a collection of outstanding researchers giving two or three lectures each as a doctoral level course for our graduate students and faculty. Our annual Sobczyk Memorial Lecture featured H.M.S. Coxeter, the world's leading geometer. In addition, one of our statistics faculty members was named the managing editor of the 20,000 circulation *Journal of Quality Technology*. The journal will be managed from our department and is a leading scholarly journal in this field.

Our faculty continued to serve the University community. One of our members has assumed responsibility as president of the Faculty Senate, another served the University on the S.C. EPSCOR committee; one of our faculty chaired the college's honors committee and our faculty remain active in curricular and computing committees. We are a nationally active group as well. Members of our faculty serve on panels for the National Academy of Sciences, in high ranking positions with the College Board, and on executive committees for two of the three national mathematics organizations. Furthermore, there are journal editors and journal board members among our numbers.

Three faculty members were on leave during the school year doing a variety of interesting things. One new faculty member joined us this year, and he already is contributing greatly.

All in all, we are proud of our yearly accomplishments, feel good about what we are doing and consider it significant and appropriate that one of our members was given the Class of '39 Faculty Excellence Award.

Medical Technology Program

The Medical Technology Program completed another productive year of teaching, advising, administrative activity and club sponsorship. The program currently

enrolls about 30 students. Five students are currently doing their senior clinical year at our hospital affiliates, completing baccalaureate degree requirements for graduation. The senior clinical-year students continue to excel on the national certification exam. All have been successful in finding employment in the profession. With serious nationwide shortages in the profession, the number and range of professional opportunities are large.

Senior-year clinical courses continue to be offered by hospital program affiliates. Formal affiliation programs are with the schools of medical technology at Anderson Memorial Hospital in Anderson, S.C., and at McLeod Regional Medical Center in Florence, S.C. Informal affiliations exist with the medical technology programs at the Medical University of South Carolina in Charleston, S.C., and the Baptist Medical Center in Columbia, S.C. The Anderson program continues to help teach the introductory medical technology course taken by new majors.

With the advent of government restrictions limiting health-care reimbursements to hospitals and other providers, many hospital-based programs in health education need to develop additional sources of funding for fiscal stability. Through the Medical Technology Committee, the University has instituted a plan whereby Clemson University provides a significant amount of support to the Anderson Hospital School of Medical Technology for each Clemson clinical student in attendance in return for a guarantee of eight places in the class. This agreement has been renewed for a second two-year period.

The current program coordinator continued to promote medical technology by group and individual presentations to students and teachers from around the state and by participation in the spring annual meeting of the S.C. Society for Medical Technology. The student Medical Technology Club completed another successful year of activities, including a trip to the Greenville Memorial Hospital Laboratory, presentations by speakers, and service projects. The club has once again been funded by Student Government for the coming year.

The program underwent its 10-year reaccreditation visit by the SACS visitation team.

Department of Microbiology

Enrollment in the educational programs was similar to the previous year: approximately 100 in the B.S.; 23 in the M.S.; and 20 in the Ph.D. Ten students were named to the President's List and eight to the Dean's List for academic achievement during the spring semester. Three baccalaureate students graduated with Senior Departmental Honors and one of these, Ms. Catherine Varner, received a National Science Foundation Fellowship to study for the doctorate degree at North Carolina State University. Thirty B.S., five M.S. and two Ph.D. degrees were awarded. B.S. and M.S. graduates either entered professional health programs or doctoral programs, or accepted positions in the private sector. The doctorates continued with postdoctoral studies at the University of North Carolina, Chapel Hill, and The University of Michigan, Ann Arbor.

Faculty research included the following: destruction of herbicides by microbes in soil; the mechanism by which a bacterial pathogen kills catfish being raised under aquaculture conditions; the effect of a pesticide on the natural immunity of catfish raised in ponds; the use of bacteriocins (natural antibiotics) to control pathogenic bacteria in sea foods; the control and regulation of enzymes important in breaking down cellulose and related compounds (the major renewable energy sources on the planet) to products that can be converted to ethanol for use as a fuel; genetic engineering of bacteria that are responsible for fixing nitrogen in agriculturally important plants, such as soybeans and clover; regulation of plant and animal genes in model microbial systems; studies of various factors, such as age, sex, smoking and stress on the ability of humans to correct harmful damage to genes; investigations into protection mechanisms against arthritis and other auto-immune diseases.

The faculty published 22 articles in professional journals, five chapters in books

and made 13 presentations at international meetings. A faculty member served as North American editor, and another as a board member, for the journal *Letters in Applied Bacteriology*. Another faculty member served on an NIH review panel for molecular genetics.

Three faculty participated in the biotechnology research program "Food Safety Through Microbiology. This is one of the University's major thrusts in biotechnology research.

The department continued to expand its interdisciplinary activities. Dr. Thomas Schwedler of the Department of Aquaculture, Fisheries and Wildlife received a joint appointment in Microbiology, and Dr. Samuel Smith and Dr. William Schmidt, physicians associated with the Greenville Hospital System, received adjunct professorships in the department.

The University was able to obtain state appropriations to construct the Incubator Laboratory Facility as a result of Dr. Ellis Kline's success in attracting two emerging biotechnology companies, Molecular Rx and Southern Bioproducts, to locate their laboratories at Clemson. They are the first biotechnology companies to be associated with Clemson in this manner.

Department of Physics and Astronomy

This year brought both progress and tragedy to the department. The best news was that Professor Donald D. Clayton was awarded the 1991 Leonard medal by the Meteoritical Society. This award was for his contributions to nuclear astrophysics and the origin of the meteorites. External funding continued to increase. It reached \$1,148,879 this year, up from \$859,575 last year and \$225,344 two years before that. The number of graduate students was 54 this year, up from 26 three years ago. Our teaching responsibilities remained at their all-time high of just over 17,000 SCH. These increases surpass our original objectives and place new strain on our available resources, including available faculty, equipment, classrooms, laboratory space and furniture. We have managed, however, to improvise. Two major research satellites with which our faculty are closely associated, the Gamma Ray Observatory (GRO) and the Combined Release Radiation Effects Satellite (CRRES), were successfully launched this year, providing exciting new data to two of our laboratories. Lewis Duncan, the associate dean for research for the College of Sciences, was promoted to full professor.

At the end of this year we lost Professor Amulya Laskar to lung cancer. He had been on sabbatical, spending time at research laboratories in Spain, France, Germany and India when he became ill. He died soon after returning to the United States. Professor Laskar was a leading researcher in the diffusion of ions through solids and played a leadership role in the department. He will be greatly missed by colleagues around the globe as well as those within the department.

Professors W. Edward Gettys and Donald P. Miller retired this year. Professor Gettys, a Clemson graduate and a theoretician, was one of our outstanding teachers on both the undergraduate and graduate levels. He chaired the department during 1987-88, leaving it in great shape. He served in leadership positions in the American Association of Physics Teachers and as AP Physics Chief Reader. Professor Miller was one of our best known teachers in the introductory physics sequence. His research was in crystallography, especially involving organic polymers. Professor Robert Panoff left the faculty to join the staff at the Supercomputing Center in North Carolina.

Dr. Dieter Hartmann and Dr. Bradley Meyer joined us from Lawrence Livermore Laboratory. Professor Hartmann obtained his M.S. in physics from Gottingen University and his Ph.D. in astrophysics from the University of California, Santa Cruz. Professor Meyer received his B.A. degree in physics from Rice University and his Ph.D. in astrophysics from the University of Chicago.

Three new faculty will join the department in the coming year. Dr. Mark Leising

comes to us as an assistant professor from the Naval Research Laboratory. He received his B.S. in physics from Notre Dame and a Ph.D. in astrophysics from Rice University. Dr. John Letaw comes to us as an associate professor from Severn Associates. He received a B.S. in physics from Clark University and his Ph.D. in physics from the University of Texas.

Dr. John Merriwether joins us as an associate professor from Phillips Laboratory (formerly the Air Force Geophysics Laboratory). He received his B.S. in chemistry from MIT and his Ph.D. in physics from the University of Maryland.

Robert (Bo) Jeanes has joined the staff as lecturer in charge of undergraduate laboratories and the design and preparation of lecture demonstrations. He received his B.S. in physics and mathematics from Presbyterian College and his M.S. in industrial education from Clemson. His presence already has made a difference.

Dr. Lawrence Brown and Dr. Robert D. Palmer joined us as research associates/assistant professor. Dr. Brown has his B.S. in physics from Southwestern Adventist College and his Ph.D. in physics from the University of Chicago. He joins Don Clayton's astrophysics group. Dr. Palmer has both his B.S. and Ph.D. in electrical engineering from the University of Oklahoma. He joins the atmospheric physics group of Miguel Larsen and Carl Ulbrich.

We received important help with our undergraduate teaching from visiting faculty Dr. John Isbell and Dr. Nasrolah Samadi. They both did an excellent job in the introductory astronomy and physics courses.

Professor John Ray received a \$150,905 grant from SCUREF. Dieter Hartmann received \$50,950 in funding from NASA during his first year as an assistant professor. Don Clayton's program received \$213,545 from NASA this year. Lewis Duncan's program received a total of \$182,361, \$86,136 from NASA and \$96,225 from NCSA. Jim Eubanks in our electronics shop received \$45,281 from Duke Power. Miguel Larsen received a total of \$179,868, \$59,868 from the Air Force and \$120,000 from NASA. G.X. Tessema's grant from NSF continued at about \$80,000 per year. Carl Ulbrich received \$125,000 from NSF. Gennady Milikh received \$28,975 from NSF and Bob Panoff received a total of \$47,275, \$30,500 from IBM and \$16,775 from the National Center for Supercomputer Applications/University of Illinois. Peter McNulty received \$124,719 from DNA. A Provost Award of \$2,000 was received this year by John Ray.

Professor Frederick J. Keller went on sabbatical this year. He spent the year at Davidson College trying new teaching approaches and enjoying the continued success of the textbook he wrote with Edward Gettys and Malcolm Skove. Phil Flower's astronomy text also continued to sell well. Both books bring considerable credit and respect to the department.

The department held its annual Physics Day in November. It was organized again by Professor Tom Collins and was the most successful ever. Forty-three high schools were represented, with 1,500 students attending. Students attended lectures and demonstrations by Professors Ray Turner, Dick Manson, Phil Flower, Don Miller and Bob Panoff, along with graduate students Matt Marone, Tim Marshall, Tim Slater and Neil Miller. High school teachers and counselors met with Professors Gilreath and McNulty over coffee. The date for Physics Day was moved earlier in the year in an attempt to increase its impact on applications to the Physics Department. There does appear to be a significant increase in the number of entering freshmen majoring in physics over previous years, but it is too early to assign a cause. It seems clear, however, that Physics Day significantly impacts recruiting in both engineering and sciences at Clemson.

DIVISION OF AGRICULTURE AND NATURAL RESOURCES

The Division of Agriculture and Natural Resources is responsible for instruc-

tional, research and public service programs in the College of Agricultural Sciences and the College of Forest and Recreation Resources.

In addition to its programs for resident instruction the College of Agricultural Sciences administers statewide public service programs that serve businesses, industry and virtually every citizen of the state. These public service functions include administration and coordination of the S.C. Agricultural Experiment Station, the Clemson Cooperative Extension Service, the Division of Regulatory and Public Service Programs and the Livestock-Poultry Health Department.

The scope of the College of Forest and Recreation Resources' programs also spans the entire state and touches the lives of all South Carolinians through teaching, research and Extension activities in forest management, wood utilization, recreation resources and services, and tourism management. Since their inception the agriculture divisions and their leaders have emphasized agricultural production and improved family life, thus laying a strong foundation for the future. As we have celebrated the University's second century, our objectives have been to increase productivity, increase employment opportunities and conserve and protect our natural resources.

Environmental concerns continue to be in the forefront of research and educational programs conducted in the Division of Agriculture and Natural Resources.

Research conducted by Clemson agronomists concerning fertilizer applications and their relationship to groundwater contamination is being passed along to farmers. The TAP, or Teaching Aquifer Protection, water quality curriculum supplement is being distributed to teachers of fourth, fifth and sixth grade students in an effort to get young people involved in the preservation and conservation of the state's water supply.

Clemson agricultural engineers are learning more about efficient solid waste management techniques to better prepare municipal governments and their citizens to comply with state legislation passed in 1991. These specialists also continue to work on techniques that will help farmers save electrical energy, time and money.

More detailed reports of each of our divisions follow.

COLLEGE OF AGRICULTURAL SCIENCES

Academic Affairs

The academic mission of the college is to provide formal and informal educational opportunities for individuals at the undergraduate and graduate levels of study to produce the expertise and leadership needed for further advancement and success of the agricultural industry. The college currently offers nine undergraduate degree granting programs in the animal and plant sciences, economics, basic and applied sciences (such as entomology; statistics; aquaculture, fisheries and wildlife; and packaging science) along with areas of emphasis in business and the environment. At the graduate level there are 11 master's level programs and eight Ph.D. degree granting programs. A number of these programs are interdisciplinary programs such as plant or animal physiology, nutrition and food technology.

Enrollment in the college has increased by 18.6 percent since the beginning of the 1990 Fall semester. Currently, there are 30.7 percent female and 2 percent black. Both undergraduate enrollment (720 students) and graduate enrollment (299 students) have shown significant increases. The undergraduate programs in Animal Science, Horticulture and Aquaculture, Fisheries and Wildlife have maintained the greatest appeal to students. The new program in Packaging Science has demonstrated substantial growth over the last two years and is projected to continue this pattern in the current year.

Two new graduate programs have been recommended for approval. The program in Environmental Toxicology is associated with TIWET (The Institute for Wildlife and Environmental Toxicology) which became a part of Clemson University in 1989. Significant graduate enrollment is expected in this program. The other recommended graduate program is Genetics which complements Clemson's Strategic Plan in focusing on Biotechnology. This program is interdisciplinary involving several colleges within the University.

Several non-traditional programs have been or are being initiated by the college. An effort is being made to offer courses to people throughout the state through telecommunications. Also, a course was received via satellite (AG*SAT) from Iowa State University and offered to students on and off campus as a part of our telecommunications program. This technology should increase our ability to reach a broader audience with greater diversity of course offerings. Efforts are continuing to successfully interact with the technical colleges to build programs of mutual interest. One such effort involves the Horticulture Department at Clemson and Horry-Georgetown Turf program.

Administratively, several changes have been made. The Departments of Animal and Veterinary Sciences and Dairy Science have been consolidated into one department. A new department in Environmental Toxicology was approved along with departmental name changes in Agricultural and Biological Engineering; Agricultural and Applied Economics; and Animal, Dairy and Veterinary Sciences. Dr. John Kelly was named department head in Horticulture; Dr. Hoke Hill, Jr. was named acting head in Experimental Statistics and Dr. Thomas Skelton was named acting head in Entomology. The college's budget was targeted with significant decreases this year as a result of the state's financial problem and the provost's equity plan. Unfortunately, the majority of the reduction affected the operating aspect of the program since faculty/staff were not laid off and/or furloughed. This reduction directly affects classroom teaching. No other alternative was available.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION SYSTEM

The South Carolina Agricultural Experiment Station System at Clemson conducts the state's only state-funded agricultural research program. Scientists in 12 departments of the College of Agricultural Sciences provide expertise for this program, while home economics research is conducted at Winthrop College.

Facilities at Clemson and at four research and education centers located across the state provide indoor and outdoor laboratories for scientists in agricultural and applied economics, agricultural education, agricultural and biological engineering, aquaculture, fisheries and wildlife, agronomy, animal, dairy and veterinary science, entomology, environmental toxicology, food science, horticulture, plant pathology and poultry science.

Branch research and education centers include Edisto at Blackville, Sandhill at Pontiac, Pee Dee near Florence and Coastal near Charleston. The Simpson Experiment Station near Pendleton also serves as an outdoor laboratory for researchers and faculty at the University campus.

Researchers at these regional centers conduct studies and carry out experiments relating to growers and crops in their respective geographic areas under constraints and conditions of different soils and climates.

During this fiscal year the Experiment Station strengthened its current research programs and also addressed future needs by responding to new concerns in the agricultural industry. Efforts are focused in three main thrust areas: agricultural productivity, quality rural environment and agribusiness development. The Experiment Station System continues to expand research programs to meet the demands and

needs of the public so they can make wise decisions based on the knowledge we provide.

In all 50 states Experiment Stations conduct both cooperative and complementary research. They avoid duplication of effort and build on the foundation of information which primarily has been responsible for advances made in agriculture during the past 100 years.

To meet future challenges the South Carolina Agricultural Experiment Station System will continue to produce new research findings to add to those of its counterparts across the country in meeting a common goal — creating better standards of living for people through the wisest and best use of natural resources.

The following summary is a capsule review of the extensive research program at the Experiment Station. Many important studies may have been omitted, and those which follow are intended only to illustrate the scope of our total program.

Agricultural and Applied Economics

The primary missions of the Department of Agricultural and Applied Economics are to conduct research that improves the efficiency of agricultural production in South Carolina; to help make S.C. agriculture more competitive relative to other geographic areas of the United States and the world; and to predict the effects of changes in national and international economic conditions and changes in U.S. government programs on agriculture and rural areas in South Carolina and nearby areas.

More than 80 percent of South Carolina's 30,823 square miles are devoted to farming or forestry. South Carolina ranks near the top in the United States in the production of tobacco (third behind N.C. and Kentucky), freestone peaches (second to California) and fresh market tomatoes (third behind California and Florida). As cotton acreage in South Carolina rebounds to around 200,000 acres, one impact of this increase will be to drive out some soybean acreage. Canola production appears to be profitable in the state, especially when double-cropped with soybeans.

Agriculture in the United States and South Carolina continues to be highly efficient. U.S. consumers now spend less than 13 percent of their disposable income on food. This compares with more than 25 percent in Japan, around 23 percent in West Germany, 40 percent or more in Mexico, at least 45 percent in the Soviet Union and more than 60 percent in China.

During the 1980s, infrastructure services in South Carolina's rural areas (including services from water and waste facilities, highways and public educational institutions) have declined significantly. In contrast, services in most suburban and urban areas (including Columbia, Greenville, Spartanburg and Charleston) continued to improve. Nine rural counties and 101 rural municipalities experienced population loss during the 1980s.

Surveys conducted in four rural counties reveal that up to 25 percent of the rural residents would move elsewhere to obtain useful employment if they could acquire enough funds to move.

U.S. consumers are growing more concerned about food safety and are willing to pay higher prices for safer food products. Preliminary studies show that consumers would pay up to 30 percent higher than presently for vegetables, 25 percent higher for chicken and 20 percent higher for beef.

Geographical Information System (GIS) techniques show that four-lane highways remain an effective means of promoting regional economic development in areas where income and employment are highest. But four-lane highways don't give the boost to economies they gave in the 1960s.

The number of farms in South Carolina decreased from 36,000 in 1978 to 25,500 in 1989. During the same period the average size of farms increased from 189 to 208 acres. By 1989 however, 55 percent of all farms still were smaller than 100 acres; the number of farms with more than 500 acres accounted for only around

10 percent of the total. The number of S.C. farms operated by African Americans decreased from 5,123 in 1978 to 2,574 in 1987.

Agricultural and Biological Engineering

The mission of the Agricultural and Biological Engineering Department is to provide the engineering output for the management of agricultural and biological systems and human and natural resources for effective and efficient production, processing, storage, distribution and utilization for the food and non-food needs of society. Five of approximately 40 active projects will be highlighted in this report.

Research on protective clothing for agricultural workers who use agricultural chemicals is being done jointly with scientists at Winthrop College and UNC-Greensboro. This has consisted of development and field testing of various materials to determine the wearability, durability and penetration of the chemicals. The initial work on using a fluorescent tracer and a computer vision system to quantify the amount of pesticides on test patches has been completed. The test patches are located under the test clothing and simulate the exposure of the worker's skin to the chemical.

Various spectral filters have been used to determine their effect on the growth of watermelon and rhododendron tissues. The purpose is to be able to modify the light spectrum in greenhouses to produce a more desirable plant. The greenhouse studies with in vivo plants under liquid dyes with various red to far red spectral ratios have shown significant modifications to plant morphology such as fresh weight and chlorophyll content.

To improve food safety in the processing of continuous-flow food-mix cooking, a laboratory experiment was designed. The purpose of the apparatus was to measure temperatures within an aseptic process of a mixed fluid like a soup mixture. A temperature capsule can be inserted into the mixed fluid and can be monitored remotely as it proceeds through the process. The capsule will simulate having a meat chunk in the food mix. To complement this data, a computer model will be developed which can predict the temperatures within a mixed fluid.

To minimize the use of energy in controlling the environment in animal structures, solar energy and waste heat recovery are incorporated in a poultry brooding facility. The objective is to develop a system that will perform the following functions: ventilation and air mixing, evaporative cooling, heating, control of interior air quality, computer control of interior environment and accurately simulate interior environment. The prototype stacked cage brooding facility is located at the Clemson Poultry Center, and the research is conducted jointly with other scientists.

Improved equipment for harvesting and handling aquaculture products is necessary as the state's aquaculture industry grows. The current phase of this project is to use electrical stimulus as a means to move catfish. Preliminary tests of the system have been completed including mapping of fields around various electrical configurations and tests to measure fish response to various frequency and voltages. These voltage and frequency conditions then will be applied to seines and sorters to speed and increase the efficiency of fish harvesting in commercial ponds.

Agronomy and Soils

Research has focused on several topics which relate to the sustainability of agroecosystems. One example is the reduction of the amount of herbicide used to achieve effective weed control. Since herbicides account for 85 percent of the pesticides used in commercial agriculture, reduction in their use will have a major impact on cost savings and lessening whatever environmental consequences may occur. Herbicide application to soybeans can be reduced by 60 percent when combined with cultivation without a penalty of reduced yield.

Alternative crops which can increase the diversity of cropping systems for par-

ticular niches in the market place are another topic associated with the economic and profitability aspects of sustainable agriculture. Production information is being developed for flax, canola and kenaf. These are three crops that appear to have potential for diversifying South Carolina's agriculture.

Nutrient management has become one of the major concerns in other parts of the country because of the appearance of measurable quantities of nitrates in groundwater. Two approaches are being followed by soil and crop scientists. One is to determine the amounts of nitrates in soils across the state to offer a "picture" of where we stand with regards to our use of fertilizers. A limited set of pesticides also is being monitored. Not enough information has been gathered yet to generalize the impact of nutrient management. The objective is to target management practices and soils which may have resulted in excessive fertilizer use.

A second approach to nutrient management research deals with more efficient use of manure and other wastes which contain nitrogen. A testing program has been developed which allows farmers to determine the nutrient content of waste before it is applied to land. This allows farmers to adjust waste applications to conform with Extension fertilizer recommendations. Proper nutrient management is saving farmers money and reduces environmental pollution.

Hagood, a new soybean variety, has been released by the S.C. Agricultural Experiment Station. The new variety is high yielding and has multi-pest resistance.

Animal, Dairy and Veterinary Sciences

The mission of the Animal, Dairy and Veterinary Sciences Department reflects the traditional philosophy of service implicit in the charge to land-grant universities. The department focuses on the state's animal agriculture needs with a clear realization of responsibilities extending to regional, national and international animal agriculture. This mission-oriented approach recognizes: the need to search for answers to questions and problems of the industry; the need to develop new knowledge upon which tomorrow's competitive advantage through efficiency will be based; and the need to apply and make available today's technology through producer education and decision-making assistance.

The research mission of the department concentrates on five species — beef cattle, dairy cattle, pigs, horses and sheep — with four primary discipline areas of breeding and genetics, reproductive physiology, nutrition and meat and dairy products. Team research, both within and outside the department and college, is utilized.

Angus, Simmental and varying percentage crosses of those two breeds were mated to bulls of the same sire breeds producing calves that were 0, 25 percent, 50 percent, 75 percent or purebred for Angus and Simmental breeding. Calves were fed silage and concentrates to target weights established by researchers at the U.S. Meat Animal Evaluation Center (USMAEC). Cattle were slaughtered in three groups with one-third of each combination slaughtered per time. Simmental sired calves had the largest loin eye area while the size decreased as the percentage of Angus breeding increased. The highest grading combination was the group of Angus-sired steer calves out of Simmental-Angus cows (averaged high choice). No significant differences existed for carcass weight or fat thickness.

Sixteen breeding crossbred, lactating beef cows were selected from a group of 156 cows based upon their lifetime productivity as measured by total pounds of calf weaned during a 10-year period. Weigh-suckle-weigh data were used to determine the amount of milk produced during a five-month period, and milk production was studied for its influence on growth. There was very little variance in milk production between the high and low-producing cows. However, there was a large variance within each of the four groups. These results suggest that high-producing cows are not necessarily producing more total pounds of calf due to their milking ability.

Beef calves from five separate sire breeds that were randomly mated to Angus dams at the Edisto Research and Education Center in Blackville were studied for the

years 1989 and 1990. Differences existed between breeds for weaning weights, with Simbrah and Santa Gertrudis calves being the fastest growing, and Angus sired calves being the lightest. Brahman, Beefmaster and Senepol sired calves were similar in growth characteristics.

Interest, participation and organizational efforts continue to grow within the S.C. beef cattle industry. Between 1979 and today, membership in the S.C. Cattlemen's Association has increased from 500 to 2,300 members, Annual Beef Conference attendance from 55 to 225 cattlemen, and from no regular communications with members to a monthly publication, "The Carolina Cattle Connection." South Carolina remains the only state without a paid employee working for cattlemen. However, a committee has been appointed and is searching for a way and the financial means of hiring an executive secretary to provide leadership to the organization.

Studies are under way to determine the metabolic effects of increasing polyunsaturated fatty acids in ruminant tissues. A lipid derivative was developed that resists biohydrogenation by stomach microorganisms, thus preventing the usual destruction of dietary unsaturated fatty acids. The effects of this lipid derivative and other fat sources on cellular membrane composition and metabolism are being studied.

Horse research projects that will improve breeding efficiency and management practices include: study of the role a stallion's hormones have on a mare's ovulation; reduced breeding frequency through timed ovulation with a hormone implant; and the study of the hormone release pattern by the pituitary gland during ovulation.

Aquaculture, Fisheries and Wildlife

The department's mission is to conduct research that will enhance management of our fish and wildlife resources. Highlights of this research are as follows.

A demonstration/research site was established on University agricultural lands to illustrate to private landowners water management practices that benefit waterfowl and at the same time complement some existing agricultural operations. During the first year (November 1990 to March 1991), 2,700 waterfowl representing seven species were observed at the site. Total duck use of the site was calculated to be more than 10,000 duck-days.

Black bears are an important component of South Carolina's mountain ecosystem. Clemson investigators in cooperation with Duke Power Company, the U.S.D.A. Forest Service, and the S.C. Wildlife and Marine Resources Department have studied the relative abundance and distribution of black bears using bait station transects since 1988. Where bears occurred, they were as abundant as bears in other Southern Appalachian Mountain states. Bear visitation to transects in 1990 was 57 percent higher than in the previous two years of observation, indicating a substantial increase in bear numbers.

Energetic measures (e.g., standing crop biomass and production) allow for a sounder ecological evaluation of stocking density of cultured clams than the more traditional methods such as growth or time to market. Based on our evaluation of a clam culture situation using these ecological measurements, stocking density of clams was grossly underestimated for the grow-out site. Knowing this type of information, linear programming techniques could be employed to obtain optimal mixes of planting densities to maximize production schedules and market potentials.

DNA fingerprinting is a new molecular genetic technique that allows examination of genetic diversity in far greater detail than past techniques. As populations of endangered red-cockaded woodpecker continue to decline, strategies for population enhancement must be tested. Using DNA fingerprinting and other techniques such as pedigree analyses, translocation strategies now can be evaluated for their usefulness in population recovery.

In October 1990 the National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) entered into an agreement with Clemson University to

house in the Aquaculture, Fisheries and Wildlife Department, NCASI's new program to study forestry/wildlife relationships in the Eastern United States. The goal of the program is to develop technical information that supports forest management systems on public, private and industry lands to provide for optimum supplies of water, wildlife and wood while maintaining healthy ecosystems.

Entomology

Entomological research is focused on pushing back the frontiers of knowledge; to render service in the form of research information to the citizens of the state, nation and world; and to develop collectively and individually as professional entomologists.

The principal research thrust is in the areas of low energy, comprehensive integrated pest management (IPM) technology. The main objective is to maintain pest populations below economically damaging levels while reducing the use of expensive and ecologically disruptive pesticides. Some examples of basic and applied research programs are listed below:

Measuring the impact of insect pests on consumer attention to esthetic factors has been a focus of recent research which identified narrow ranges of consumer tolerance to damage. Most retail consumers have only vague notions about the causes of damage. Our research on the biology, seasonality, population dynamics and regulation of pests on popular selections of Southern ornamentals such as crepe myrtles and azaleas will provide a basis for pest management strategies in nursery vs. landscape situations.

Corn studies indicate that *Archytas marmoratus* and *Camoletis sonorensis*, two primary early-season parasitoids of corn earworm, have distinctly different host-use patterns. Geostatistical spacial analysis techniques indicate that corn earworm populations are relatively uniform in their dispersion. Larvae parasitized by *A. marmoratus* tend to be distributed along specific rows, perhaps indicating that these parasitic flies move along row middles in their search for hosts. Larvae parasitized by *C. sonorensis* occur in small clumps throughout a field, indicating that these parasitoids remain in the immediate area where the first host was located. Understanding the basic biology of these natural control agents is important in effectively managing corn earworm populations.

Insect pests are a major threat each year to the state's tobacco production. Although their numbers and damage have not decreased, the number of insecticides available for farmer use has decreased. Also, fewer and fewer insecticides are being registered for use on tobacco. The use of insect-resistant tobacco appears more important than ever. Research efforts have produced a number of breeding lines that are resistant to tobacco budworms and aphids. Significant progress has been made, and several of these breeding lines with improved plant characteristics and acceptable leaf chemistry currently are being evaluated by the appropriate committees for release as potential cultivars.

Using an approach that combines biochemistry, molecular genetics and physiology, the functions of two insect neuropeptide hormonal systems in the regulation of insect growth and behavior are being characterized. Results indicate that these can be exploited for the development of safe, specific and effective methods to protect plants from insects.

Neither cotton yields nor earliness were significantly affected by insecticide treatments directed against early-season (June) tobacco budworms and bollworms, indicating that early season control of this pest complex is not always necessary and that our treatment thresholds need to be re-evaluated. This could result in significant savings for growers.

In a mid-season (July-August) threshold study, three insecticide applications to cotton using a tobacco budworm-bollworm larval threshold produced yields comparable to yields produced using egg threshold (6-10 applications). Fewer insecticide applications would significantly decrease the cost of cotton production, conserve

beneficial arthropods, reduce environmental contamination and decrease the chance of these pests becoming resistant to our available insecticides.

Many chemicals are being evaluated for ovicidal activity against bollworms and tobacco budworms. Ovasyn, Curacron, Lannate, Larvin and the pyrethroids Scout, Asana, Karate and Baythroid were found to be extremely effective.

Numerous chemical and biological control agents are being evaluated for effectiveness against insects on cotton. Results of these tests are extremely important to state cotton growers because they are incorporated into Clemson's cotton insect control recommendations.

Several new strains and formulations of the biological insecticide, *Bacillus thuringiensis*, are being evaluated for control of tobacco budworms and bollworms in cotton. An experimental encapsulated endotoxin of this bacterium was found to be effective against these pests.

Food Science

Interdisciplinary fundamental and applied research continues to be the major emphasis of the Department of Food Science. The department conducts research in the disciplines of food science, nutrition and packaging. Integration of these areas of expertise provides a unique combination of talent which is unmatched at any other land-grant university.

Emulsion characteristics of egg proteins were investigated, showing the effect of those proteins on the ability to form films in processed cakes and other bakery products. To extend the shelf life of emulsified poultry meat products, the effects of light and oxygen on vacuum packaged turkey bologna were investigated. Results show that color changes, and the amount of energy necessary to initiate such changes in meat color can be predicted.

A major effort to utilize packaging to extend shelf life of value-added agricultural products continues. A three-day extension of color and nine-day extension of microbial characteristics of fresh ground lamb were obtained when packaged and stored properly. Appropriate packaging and microwave pasteurization for whole egg products were studied to provide safe, shelf-stable whole eggs, an important commodity in South Carolina. Packaging methods for fruits and vegetables are being studied to establish a longer market window for those fresh S.C. products.

A new protein separation process designed by the Food Science Department has been patented and could have a substantial impact on the food and biotechnology industries. The process utilizes metallic membranes to remove certain proteins from fluid streams while enhancing other proteins in that stream. The concept holds great potential for a variety of food and drug products. The process could separate enzymes and other proteins produced by fermentation from genetically engineered organisms. Those components, in turn, could be extracted and used in food and pharmaceuticals. Growth regulation proteins and hormones produced through tissue or cell culture could be isolated without losing potency. Development of the latest patent follows an earlier patent whose technology is owned by Du Pont.

A new packaging laboratory is scheduled for completion by spring 1992. An initial Experiment Station grant of \$200,000 in program funds for packaging equipment resulted in an endowment of \$500,000 from private industry (Sonoco Corp.) solely for the purpose of equipment purchase for the packaging lab. Additionally, Cryovac Corp. has established a \$1.5 million endowment to create a Trustees Chair in Packaging. The resulting application of resources soon will result in a world-class packaging program at Clemson.

Program research in processing and packaging has resulted in a cross-disciplinary research effort in new and innovative applications of food science, nutrition and packaging. Methods for packaging S.C. fruits, vegetables and floral products to compete in the international marketplace is in the beginning stage of investigation.

Food processing program funds have allowed the acquisition of processing

equipment and funding to develop a significant food processing research effort. Investigations into a thermal process model for continuous-flow food mix cooking will allow development of equipment for efficient processing of S.C. food products.

Participation in the food safety through biotechnology program of the Experiment Station has resulted in identification of certain species of microorganisms producing proteins (bacteriocins) which in turn inhibit selected food spoilage organisms and show promise for inhibiting certain food pathogens. Isolation of such proteins will allow new concepts for providing safe and nutritious food. Methods by which bacteriocins can be utilized in food products, specifically in processed meats, are a major effort of the department and are breaking new ground in applied research for value-added processing.

Horticulture

The Horticulture Department's mission is to discover new knowledge through research and to teach traditional and new knowledge to a broad range of students. Undergraduate and graduate students, members of the horticulture industry, and the consuming public are benefactors of these educational efforts. The following items are research highlights from this past year.

Spectral liquid filters used as a greenhouse covering regulates the height of tomato transplants without affecting yield after transplanting to the field. Another study using spectral filters demonstrated that excellent quality poinsettia and chrysanthemum pot plants could be produced without using chemical height retardants.

End-of-day supplemental fluorescent lighting of tomato transplants resulted in shorter, more manageable plants without the use of growth inhibiting chemicals. The end-of-day light treatment had no effect on subsequent fruit production in the field.

A plastic mulch system for growing vegetables in the field that changes color with season has been developed. The system uses a black photodegradable mulch on top of a white non-photodegradable mulch. The system has been used successfully with tomatoes and squash.

Membrane-based tissue culture systems are being designed to automate micro-propagation of triploid melons, orchids and begonias. Environmental parameters and mechanical handling of plant materials are being integrated into systems.

Watermelon and muskmelon regenerant populations contain a high proportion of polyploids useful for the breeding of triploids. Following selection, new tetraploids parents will be used in breeding triploids.

Commercial seed lots of watermelon contaminated with watermelon fruit blotch may have arisen in certain provinces of China. Resistance to watermelon fruit blotch already may exist in the old variety from Charleston — Congo.

The Carogem peach was released for grower trial by the Agricultural Experiment Station. Carogem is a reliably cropping mid-season peach ripening three to four days before Redglobe peach. The testing of Carogem has been carried out in the state's three peach growing areas represented by sites at Spartanburg, Edgefield and Orangeburg counties, with the best overall performance observed in the Piedmont region of Spartanburg.

Plant Pathology and Physiology

The Department of Plant Pathology and Physiology is responsible for developing cultural, chemical and biological controls. The faculty and staff do basic and applied research on plants and disease causing organisms, test controls sold by commercial companies and develop resistant varieties. Major plant disease causing organisms are fungi, nematodes, viruses and bacteria. The nature, action and fate of

pesticides in the environment also are projects of plant pathologists and physiologists.

There are few pesticides to control plant parasitic nematodes, but nematodes are constant pests in South Carolina. Several experiments featuring non-chemical approaches to control can be reported. Crop rotations involving root-knot nematodes and tobacco can be recommended. Corn, cotton, sorghum and rye-fallow improved yields over continuous tobacco, and there is no difference between rotation crops. Cotton and corn favored the less harmful kinds of root-knot nematodes. Several varieties of corn and small grains have been tested so that recommendations can be made. In another set of experiments root-knot nematodes damaged tomatoes less when the tomatoes were grown on white or red plastic mulch in contrast to using black plastic.

Columbia lance nematodes from several locations were tested for their ability to cause damage to cotton. Like the root-knot nematodes, more than one race is present in the cotton and soybean growing areas of the Southeast. A survey for soybean cyst nematodes showed at least five races of that nematode present in South Carolina.

Because of the many races of nematodes present in South Carolina, it is important to know which race is present in any given field before recommendations are made. Work was done to find ways to better separate the major groups of nematodes. DNA from nematode eggs was broken into fragments, unique fragments were cloned, and those fragments were matched with DNA from different populations. It was shown that such a system was feasible for distinguishing races of nematodes. When the race is better known, decisions can be made regarding crop variety selection when planting.

Ring nematodes and associated peach tree short life have been objects of intense research the past few years. Several peach rootstocks better than the standard Lovell have been identified. One, and perhaps two, have characteristics of a good rootstock for South Carolina. In addition, two plum seedlings and two other *Prunus* species have been found that limit ring nematode populations. These rootstocks by themselves are not suitable for orchard use but represent breeding stock for tolerance to ring nematodes.

Soil collected from a pesticide disposal site had an active population of various types of microorganisms including bacteria and fungi. Specific microbes were isolated that actively reduce some of the compounds to their basic elements in the laboratory. Field tests will be made.

Poultry Science

The research effort in the Poultry Science Department is to advance the basic knowledge of poultry. Fundamental research is conducted in environmental science, immunophysiology, genetics, nutrition, pathology, physiology and reproductive endocrinology. The department's long-term research emphasizes the molecular approach to research. The specific needs of the poultry industry are included in planning the department's research.

To stimulate cooperative research the department initiated an umbrella program in 1987, "Immunoenhancement of the Embryo" (IMENEB). The concept of IMENEB was, in part, responsible for the initiation of numerous new research efforts.

The semen of domestic birds, especially that of the broiler breeder, turkey and guinea fowl, contains immunoresponsive cells known as spermiophages. Spermiophages actively engulf and destroy germ cells and, when activated, release granules which are involved in sperm clumping. The clumping will remove sperm cells from semen and may be the major reason for reduced fertility when pooled semen is used.

Activation of spermiophages in vitro leads to an increase in size and the appearance of numerous motile cytophasmic granules. The granules are exudated and ap-

pear to be involved in the production of mucous-like material which traps other cells and bacteria. The granules may be L-forms of a bacterium.

The injection of day-old chicks with antibodies to fat cell membranes reduced body fat by 25 percent, but may have undesirable side effects related to the binding of numerous membranes.

Mature hens injected with specific pathogens will deposit in the egg yolk, large quantities of antibodies specific to these pathogens. The antibodies are harvested from the egg yolk and used in diagnostic and "proactive" studies.

Genetic material has been extracted from *Pasteurella multocida* and cloned in *Escherichia coli*. Subcloning should help identify a clone that will produce "proactive" antigens to *Pasteurella*.

Specific products of thymic epithelial cells may contribute to the induction of T-lymphocytes which are important in the immune response.

The bursa of Fabricius is a unique gland in the chicken in which B-cells, the cell ultimately responsible for antibody production in cell vertebrates, differentiate. B-cell differentiation is dependent on the presence of a novel cell, the bursal secretory dendritic cell. The bursal secretory dendritic cell may exert its influence by secreting a specific protein which influences B-cell differentiation.

The Harderian Gland in the chicken is unique in that it possesses the highest concentration of plasma cells, antibody producing cells, of all vertebrates. The proliferating plasma cells of the Harderian Gland are used as models to investigate the secrets of immunity.

The Institute of Wildlife and Environmental Toxicology (TIWET)

The Institute of Wildlife and Environmental Toxicology (TIWET), which was established at Clemson University in 1989, has clearly defined its mission, "excellence in research, education and public service programs in environmental toxicology." These programs serve as a foundation for resolving ecological conflicts between aquatic and terrestrial wildlife resources and toxic substances released into the environment. TIWET has added an aquatic toxicology section and formalized a quality assurance section to complement the existing ecotoxicology, biochemical/behavioral toxicology and analytical toxicology sections.

During fall 1990 TIWET moved into its new headquarters in Pendleton. The building is a 37,000 square-foot facility which comprises administrative space, laboratory space and an animal unit with a staff of more than 100 full-time personnel including administrators, faculty, staff and a consulting physician. The facility was constructed and furnished with funds resulting from extramural research projects being conducted by institute personnel. TIWET's budget during 1990-91 was approximately \$5 million, and this is expected to increase to more than \$6 million in 1991-92.

A new project generating a large amount of interest is the work on the S.C. coast which involves development of environmentally sensitive techniques for golf course management. Another project attracting public interest is the work with banana plantations in Costa Rica where TIWET researchers currently are investigating the effects of the runoff from these operations on the fish and avian species of Costa Rica.

Ecotoxicological studies involving chemicals used in agricultural production in the Midwest continued and were expanded during the past year. These studies have greatly increased the knowledge of the biological effects of contaminants as well as the ecology of many avian species. Large scale, multi-year studies also have been initiated to investigate the effects of runoff on farm ponds in the Midwest and the effects of contaminants on wildlife utilizing hazardous waste sites.

TIWET's greatest accomplishment this past year was the formation of the new academic Department of Environmental Toxicology within Clemson's College of

Agricultural Sciences. This department and TIWET share a common mission and will work closely together and with many other programs on campus to produce a graduate program in environmental toxicology which is unequaled elsewhere. TIWET has added several faculty members to its staff, bringing the total number this fall semester to 13. It also is supporting the work of 23 graduate students. This number is expected to reach 35 by January 1992.

Coastal Research and Education Center

The primary responsibility of the Coastal Research and Education Center is to develop efficient and economical systems for commercial vegetable production in South Carolina. A primary goal is to become a center of excellence for vegetable research.

Experiments were carried out to assess the feasibility of using plastic shrink wrap to improve the storage and export potential of seedless and seeded watermelons. Melons were shrink wrapped and stored at three different temperatures. Packaging in shrink wrap did not influence color, sugar content or rind thickness. A bio-cidal plastic film to help prevent decay from microorganisms will be incorporated into the studies this year. Results from this research should greatly increase the possibility of exporting watermelons from South Carolina to foreign countries, especially Europe.

Synthetic pyrethroid insecticides caused an increase in populations of the diamondback moth, a serious pest of crucifers. Several biological control materials, including a bioengineered *Bacillus thuringiensis* product, are being studied to determine their capability of controlling this pest without the harmful residues and other undesirable side effects associated with broad spectrum chemical insecticides. Intensive field sampling revealed that more than 90 percent of diamondback moths were parasitized in plots where chemical insecticides were not used.

Scientists are assessing the biological control potential of *Apanteles ruveular*, a parasite imported from China that attacks the imported cabbageworm, a major insect pest of cruciferous crops in South Carolina. Simplified field scouting techniques have been developed and preliminary data reveal that field sampling to determine whether insecticides are needed is more economical compared with standard grower practice of weekly insecticide applications. Results from these experiments along with appropriate action thresholds and biological control agents will form the basis for more cost effective and environmentally sound control of insect pests.

Asparagus forced into harvest for the third year from transplanting in 1986 from July to September produced yields similar to spring harvests. Profitability for forced asparagus was significantly higher for forced summer/fall asparagus than those harvested in spring. Forcing asparagus has great potential as a new commodity for the state's coastal growers.

Broccoli can be grown successfully as a fresh market (spring/fall) product and also as a fresh market chopped product. Results from the third year of this field research continue to indicate great potential for broccoli as another new commodity for S.C. growers.

Edisto Research and Education Center

The Edisto Research and Education Center's mission is to conduct research, extension and teaching programs that focus on agricultural problems unique to the Coastal Plains region. Emphasis is placed on problems that demand multi-disciplinary team approaches for solutions. The goal of the center is to develop, evaluate and transfer new and improved technology and to incorporate this information along with traditional practices into production systems that enhance agricultural production and profit while protecting the environment and natural resources.

New soybean varieties with multiple resistance to nematodes were released, and

other breeding lines showed promise for future releases. Studies on soybean looper populations reconfirmed that in South Carolina this pest is resistant to permethrin, but in other experiments it was controlled by Larvin (thiodicarb) and biological products Condor and Dipel ES.

Parasitic wasps were very helpful in regulating populations of budworms and bollworms in cotton early in the growing season. Research on cotton indicates that early season *Heliothis virescens* control may not be necessary since data from two years show no yield differences in treated and untreated plots. Biological products plus an ovicide provided adequate control of *Heliothis virescens*.

Field and greenhouse experiments to determine the feeding behavior and economic value of three peanut pest (corn earworm, granulate cutworm and fall armyworm) indicate that these insects cause significant damage to peanut pods. On-farm tests measured net treatment returns of \$8 - \$220 per acre depending on larval populations.

Three crops that are relatively new to the region were evaluated. Canola yields comparable to other regions were produced, but as in previous years there were great differences in adaptation and performance of varieties when planted in the Southeast. Soybeans were successfully planted as a double crop behind canola. Flax planted in the fall had higher yields than when planted in the spring. A kenaf variety test was conducted and results suggest that this crop has potential for the region.

Interseeding soybeans and cotton into wheat in conjunction with controlled traffic continued to be an effective means of conserving energy and reducing erosion without reducing yields as compared to conventional systems of growing these crops.

Forage production from rye pastures was greatly influenced by the quantity of forage present in the field prior to initiation of grazing. Production and carrying capacity of winter pastures were enhanced by grazing management without additional capital inputs. Leaf surface area in conjunction with readily available carbohydrate reserves may be the factors that contribute to the observed responses.

During the year eight field days were held, a short course for science teachers was conducted and three graduate courses were taught at the center. Work continued on plans for a new multi-purpose headquarters building, and a pesticide handling-storage facility.

Pee Dee Research and Education Center

The Pee Dee Research and Education Center was established in 1911 to meet the needs of growers producing the major crops being grown in the region which amount to more than 50 percent of the agricultural income within the state.

Scientists at the center have concentrated on areas which impact the economic returns to growers as well as practices that affect the environment. Research efforts have centered on tobacco, cotton, soybeans, small grains, corn and vegetable production.

Results with wheat production indicate that increased nitrogen fertilization is partially limited to insufficient soil moisture during rain fall. Preliminary tests indicate that soil testing for nitrogen has the potential for use in adjusting spring nitrogen applications in wheat.

Vegetable cropping systems have shown great potential for mung bean and pea bean production in the region and were advanced to on-farm demonstrations last year. Mung beans proved successful enough to be produced commercially on a small scale in 1991.

High density polyethylene plastic mulch was tested for multiple crops without the normal displacement. This could benefit growers through reduced costs of installation, disposal costs, as well as reduced environmental disposal problems while maintaining a high yield and quality output.

Scientists working with cotton insect control found that larval thresholds for

bollworms and tobacco budworms were as effective as egg thresholds, resulting in fewer insecticide applications being needed. Other scientists working in tobacco insect control have made considerable progress in developing breeding lines that are resistant to tobacco budworms and aphids.

Research continued on tobacco disease control. Granville wilt, a serious tobacco disease that continues to increase in the state, was shown to be suppressed with broadcast application of 1, 3-D Chloropicrin. This will provide growers with greater flexibility in weed control as well as disease control in tobacco.

Work began in turf investigations with several acres of turf plots being established. Work in this area included disease and insect control along with nitrogen and water management.

Sandhill Research and Education Center

The mission of the Sandhill Research and Education Center is to conduct research and extension programs in fruits, vegetables, ornamental crops and swine.

A survey of selected peach orchards in the state's Piedmont, Ridge and Coastal Plains regions recently was completed. The orchards had been included in an earlier survey completed in 1987 and were revisited and samples collected to confirm that Prunus necrotic ringspot virus (PNRSV) was spreading within these orchards and to determine if a second virus (prune dwarf virus PDV) also was present. Substantial increases in the incidence of PNRSV compared with the figures reported for 1987 indicate that this virus is spreading naturally among trees in orchards. The presence of PDV was confirmed in orchards in the state, but despite the frequent occurrence of both viruses, few trees that were infected with both PNRSV and PDV were found. Surprisingly those trees that were infected with both PNRSV and PDV did not exhibit symptoms of peach stunt, a disease caused by infection with both viruses and which is at present causing severe problems in some areas of California.

A peach seedling rootstock has been selected for regional testing after significantly increasing peach tree longevity on severe peach tree short life sites at the center. Trees budded to this rootstock grew faster and had less short life mortality than trees on Lovell rootstock, the commercial standard. Another peach genotype has been used successfully as an interstem to delay peach flower phenology. This interstem selection has delayed full bloom eight to 15 days for peach varieties that bloom too early.

The critical leaf nitrogen concentration for green bunching onions was determined to be 3.9 percent. The nitrogen sufficiency range for green bunching onions should be established at 3.9 to 4.9 percent. It also was determined that the optimal postplant nitrogen program for green bunching onions, grown on the Lakeland sand soil, is to apply 22 to 45 kg of nitrogen every two weeks starting four weeks after planting.

Top Bunch, a hybrid collard cultivar, was found to be more efficient in utilizing nitrogen in sand culture and field studies. Increasing the total postplant nitrogen rate from 45 to 67 kg/ha resulted in no yield increase for Vates; however, it resulted in a 6,700 kg/ha increase in yield for Top Bunch and 4,500 kg/ha for Heavi Crop. These accomplishments in nitrogen management for vegetable crops grown on the Lakeland sand soil will reduce the cost of production for the growers and reduce the amount of nitrate that is leached into the groundwater.

Application of nutrients through the drip irrigation system is as effective in producing field grown Nelle Stevens holly as dry fertilizer application on an equal rate basis.

Wildflower plantings conducted with the S.C. Department of Highways and Public Transportation have been established at 19 locations around the state. Additional plantings will be made in fall 1991. Wildflower research plots have been set up at the center to evaluate species and mixes.

The National Crabapple Improvement Program has been initiated at the center

with the planting of seven new cultivars. This program is in addition to the National Crabapple Evaluation Program which contains about 51 cultivars.

The Swine Evaluation Center, located at the center, conducted genetic evaluations on three groups of boars totaling 169. An electronic feeding system was evaluated to compare boars in a group environment by obtaining individual feed consumption on a daily basis. This is the first boar test station in America to utilize this procedure.

Active Research Projects 1990-91

Agricultural and Applied Economics

Marketing strategies for agronomic crops with uncertain prices and yields.

Analysis of structural and organizational challenges in rural counties in the South.

Changing patterns of food demand and consumption behavior.

Potential for community economic development and its impact on rural residents.

Economic and technical forces shaping the Southern dairy industry.

Competition and change in the fruit and vegetable production and marketing system.

Agricultural adjustment in the Southeast through alternative cropping systems.

Econometric analysis of yields of major agronomic crops in South Carolina.

Changing structure of local labor markets in non-metropolitan areas.

Quantifying long run age risks and evaluating farmer responses to risk.

International trade research on commodities important to the Southern region.

Economics of wetland preservation.

Economics of disadvantaged regions.

Transformation of agriculture: resources, technologies and policies.

Econometrics analysis of employment in agribusiness industries.

Economics of wildlife resources.

Forward pricing mechanisms to manage agricultural risk in South Carolina.

Agricultural Education

Diffusion of technology to traditional and non-traditional agricultural education clientele.

Agricultural and Biological Engineering

Automatic control of field machine functions for increased efficiency and energy conservation.

Compost for control of apple collar rot.

Hydrologic/water quality modeling of sediment and chemical movement.

Control prediction, economics and environmental effects of soil erosion.

Agricultural application of machine vision system.

Dynamic modeling of water quality in aquaculture.

Edible films from cereal grains and soybeans.

Predicting groundwater recharge in the Piedmont.

Integrated systems and controls for processing and storing agricultural commodities.

Systems for providing and controlling interior environments for poultry and livestock.

Development and verification of a thermal process model for continuous-flow food mix cooking.

Barrier and mechanical properties of edible, degradable films produced from soy and cereal protein.

Meteorological research and agricultural management modeling for Southern agriculture.

Engineering systems for plant tissue culture.

Ground surface sensing through plant foliage.

Effects of spectral filters on micro-propagation morphology for mechanization.

Management of animal waste in support of sustainable agriculture and quality water resources.

Improved harvesting, sorting and production practices for channel catfish and crawfish.

Agronomy and Soils

Chemistry of atmospheric deposition: effects on agriculture, forestry, surface waters and materials.

Characterizing plant traits for improved crop performance.

Mineralogy of selected soils in the Southern region.

Weed control and herbicide resistant weeds in corn, cotton and soybean.

Effect of soil test values and fertilizer amendments on the nutrient content and yield.

Enhancing beneficial microorganisms in the rhizosphere.

Variability of soil properties and its effect on water quality and soil management.

Cellular and molecular genetics for improvement of maize and fescue.

Chemical parameters affecting aluminum biogeochemistry in Southeastern U.S. soils.

Grain yields and field performance evaluation of barley, oat, rye, triticale and wheat.

Cultivar performance evaluation of corn, cotton, grain sorghum, peanuts and soybeans.

Breeding tall fescue in South Carolina.

Mixed species pasture establishment and persistence.

Animal, Dairy and Veterinary Sciences

Nutrition and management of swine for increased reproductive efficiency.

Improving reproductive efficiency of cattle and swine.

Physiology of pregnancy and embryo survival.

Forage components that influence nutrient digestion and metabolism in ruminants.

Effects of aflatoxin B-1 on bovine and avian T-cell function in vitro.

Bovine somatotropin (BST) in lactating dairy cows and concentration in dairy foods.

Genetic potential of beef cattle for forage utilization.

Genotypic evaluation of Zebu and British-continental cattle.

Effects of defined serum replacements and growth factors on cultured ovine and bovine embryos.

Development of profitable beef forage production systems for the Southern region.

Genetics of body composition in beef cattle.

Rapid determination of milk shelf-life using antibodies to spoilage.

Selection for improved growth of muscle in swine and the effects on hot processed meat products.

Effect of dietary toxins on cellular immunity in cattle, chickens and horses.

Growth of muscle and deposition of fat in beef as related to genetics and forages.

Influence of seminal estrogens on uterine and ovarian functions in the mare.

Expression and function of oviductal growth factors during early embryogenesis in the pig.

Feasibility of reduction of fat percentage in fresh pork sausage.

Dairy herd management strategies for improved decision making and profitability.

Evaluation of beef cattle germ plasm resources involving additive and non-additive genetic effects.

Aquaculture, Fisheries and Wildlife

Biology of clams, whelks and other important shellfish.

Delta waterfowl and wetland research station — Atlantic Flyway Station.

Environmental requirements and transport related stress in hybrid striped bass and red drum.

Status of the green salamander in South Carolina.

Black bear demography, habitat use and home range in South Carolina.

Abundance and diversity of fishes in relation to stream habitat.

Biological Sciences

RFLP and molecular analysis of root-knot nematodes, nematode infected plants and peaches.

Entomology

Management strategies for insect pests of alfalfa.

Management and biology of arthropod pests of livestock.

Integrated management of cockroaches in structural and industrial environments.

Control of selected insects and mites attacking ornamental trees and shrubs.

Improved systems of control for pecan arthropod pests.

Behavioral relationships of selected pest and nonpest Lepidoptera.

Biology and management of filth flies and other arthropod pests.

Black fly damage thresholds, biology and control.

Behavioral and control studies of red imported fire ant.

South Carolina participation in NAPIAP.

Cloning and analysis of genes for insecticide resistance.

Identification of immature insects by mitochondrial DNA restriction profile.

Bionomics and interactions of corn earworm parasitoids with area-wide management control.

Biology and management of peach arthropods.

Identification and distribution of insects of potential importance in South Carolina.

Development of entomopathogens as control agents for insect pests.

Development and reproductive behavior of selected Tachinidae parasitizing *Helicoverpa* (+ *Heliothis*) *zea*.

Food Science

Functional properties of food proteins.

Development of new processes and technologies for the processing of poultry products.

Immobilization of cells and enzymes on metallic membranes for production of food components.

Mineral binding to components of dietary fiber.

Packaging of food products for maximum quality and extended shelf life.

Combined technologies for enhancement of quality in intact and formed meat products.

Egg product development: sliceable, encased ready-to-reheat whole egg products.

Packaging of fresh vegetables for maximum quality and extended shelf life.

Bacterins from lactic acid bacteria to improve food safety.

Effect of diet on bone noncollagenous proteins.

Characterization of inhibitors produced by food-bioprocessing propionibacteria.

Home Economics Extension

Moisture damage in South Carolina housing.

Home Economics Research (cooperative with Winthrop College)

Textile fiber systems for performance, protection and comfort.

Nutritional status and body composition of healthy, black, normal-weight, middle-age females.

Horticulture

- Plant germplasm: its introduction, maintenance and evaluation.
- Quality maintenance and improvement of fresh market peaches and apples.
- Breeding of watermelon and evaluation of muskmelon varieties.
- Improving plastic mulch and row cover crop systems for vegetable production.
- Weed management in cucurbit crops.
- Temperature effects on growth and flowering of kiwi fruit.
- Extending shelf life of floricultural crops by manipulation of postharvest environment.
- RFLP analysis and DNA fingerprinting in rose cultivars.
- New flowering pot plants through chemical growth regulation and/or environmental manipulation.
- Ornamental plant production and impact of slow-release nitrogen fertilizer on surface water.
- Evaluation of turfgrass cultivars and herbicides.
- Improved melon cultivars.
- Tall fescue and bermudagrass cultivars for Eastern transition zone turf.
- Ornamental herbicide movement, contamination and modification in runoff and surface water.
- Nitrogen and carbohydrate balance in episodic plants.
- Stress physiology and cultural management of peach.
- Breeding improved peach, nectarine and rootstock cultivars.

Plant Pathology and Physiology

- Biochemical and residual properties of pesticides.
- Herbicide resistance and metabolism in tissue culture.
- Causes and control of diseases of cereal grains with emphasis on powdery mildew of wheat.
- Biology of genetically changing root-knot and cyst nematodes of soybeans.
- Distribution, ecology and pathogenicity of root-knot nematodes.
- Control of peach tree short life in South Carolina.
- Physiology and molecular genetics of selected plant-bacterial interactions.

Forage legume viruses: identification and genetic resistance for improved productivity.

Control of nematodes on peach and diseases of peach and apple trees.

Poultry Science

Reproductive efficiency of turkeys.

Amylases in chickens: molecular basis and effects on growth rate.

Function of a secretory cell, a Dendritic cell, of the bursa of Fabricius.

Functional enhancement of immune system during embryonic development.

Genetic relationships to growth and reproduction in diverse poultry populations.

Role of A-P-4-A in stress responses of animals.

Effects of cooling avian embryos: immunocompetence and stress.

Production and evaluation of anti-pasteurella antibody from egg yolks.

Immunoglobulin A as an indicator of protection in fowl cholera vaccinated turkeys.

Coastal Research and Education Center

Urban horticulture for coastal South Carolina. (Horticulture).

Breeding fresh market tomatoes for bareground unstaked production (Horticulture).

Production potential of summer and fall harvested asparagus in coastal South Carolina (Horticulture).

Management of insect pests of vegetables (Entomology).

Storage potential of South Carolina melons using modified atmosphere packaging (Horticulture).

Improving the export potential of South Carolina watermelons using modified atmosphere packaging (Horticulture).

Improvement of stand establishment and yield of alternative vegetable crops for South Carolina (Horticulture).

Edisto Research and Education Center

Engineering improvement and management of forage harvesting and conditioning systems (Agr & Biol Engin).

Physical and chemical characteristics of forages and their relationships to forage quality (Animal, Dairy, Vet Sciences).

Arthropod induced stress on soybean: evaluation and management (Entomology).

Management of *Hoplolaimus columbus* nematode on cotton and soybean (Plant Pathology).

Endemic and imported natural enemies of soybean and cotton insect pests (Entomology).

Insect management in reduced cost cotton production systems (Entomology).

A new reduced tillage, wheat-soybean intercropping system for South Carolina (Agr & Biol Engin).

Biological control of selected arthropod pests and weeds through introduction of natural enemies (Entomology).

Pee Dee Research and Education Center

Impact of integrated crop management practices on European corn borer and related stalk boring insects (Entomology).

Effect of European corn borer population density on injury to corn (Entomology).

Tobacco curing models for maximizing efficiency in bulk box barns (Agr & Biol Engin).

Cotton breeding for improved quality, insect resistance and production efficiency (Entomology).

Breeding disease and *Meloidogyne arenaria* resistant flue-cured tobacco (Agronomy & Soils).

Cultural practices and variety testing for flue-cured tobacco (Agronomy & Soils).

Tobacco disease and nematode control (Plant Pathology & Physiology).

Influence of mulches on nematodes and diseases in tomato and corn (Plant Pathology & Physiology).

Management strategies for arthropod pests of cotton (Entomology).

Economic management of tobacco insects pests (Entomology).

Environmental stress and production practice effects on the growth and physiology of agronomic crops (Agronomy & Soils).

Soil and plant nitrogen tests for predicting nitrogen fertilization of wheat (Agronomy & Soils).

Integrated crop management effects on stalk-boring Lepidoptera (Entomology).

Sandhill Research and Education Center

Environmental and biological stresses of rootstock in peach tree longevity (Horticulture).

Rootstock and interstock effects on peach physiology (Horticulture).

Production systems for cool season vegetable crops (Horticulture).

Viruses and viral diseases of peach (Plant Pathology & Physiology).

Technical and economical efficiencies of producing and marketing landscape plants (Horticulture).

Virus and virus-like diseases of woody, deciduous fruit crops (Plant Pathology & Physiology).

Rootstock and interstem effects on pome and stone fruit trees (Horticulture).

Microirrigation of horticultural crops in humid regions (Horticulture).

Technical Contributions

- 3088 PHYTOCHROME-REGULATED GROWTH OF CITRULLUS by Dennis R. Decoteau and Heather H. Friend (Horticulture 7-05-90).
- 3089 THE TRIBE MEGASTERININI (COLEOPTERA: HYDROPHILIDAE) OF CHINA by WU wu and PU Zhelong (Entomology 7-13-90).
- 3090 EFFECT OF DIET ON BONE MATRIX CONSTITUENTS by Z.K. Roughead and M.E. Kunkel (Food Science 7-20-90).
- 3091 EFFECTS OF PESTICIDE DEGRADATION PRODUCTS ON SOIL MICROFLORA by N.D. Camper (Plant Pathology and Physiology 7-24-90).
- 3092 RELATIONSHIPS AMONG NITROGEN, PHOSPHOROUS, AND POTASSIUM FERTILITY REGIMES ON TOMATO TRANSPLANT GROWTH by Regina R. Melton and Robert J. DuFault (Horticulture 7-25-90).
- 3093 EFFECT OF AMMONIUM CARBAMATE ON NUTRITIVE AND PRESERVATIVE CHARACTERISTICS OF HIGH MOISTURE COASTAL BERMUDAGRASS HAY by L.J. Johnson, D.L. Cross, T.C. Jenkins, A. Khalilian and L.M. Redmond (Animal and Veterinary Sciences 8-01-90).
- 3094 EFFECT OF FEEDING GARLIC OIL ON PERFORMANCE AND EGG YOLK CHOLESTEROL CONCENTRATION by R.V. Reddy, S.F. Lightsey and D.V. Maurice (Poultry Science 8-01-90).
- 3095 DROUGHT-STRESSES CORN SILAGE by D.L. Cross, W.J. Caldwell and L.M. Redmond (Animal and Veterinary Sciences 8-01-90).
- 3096 EFFICACY OF NORGERTOMET AND ESTRADIOL VALERATE by S.L. Pratt, J.C. Spitzer, G.L. Burns and B.B. Plyler (Animal and Veterinary Sciences 8-01-90).

- 3097 HIGH MOISTURE FESCUE by D.L. Cross, M.D. Grotheer and L.M. Redmond (Animal and Veterinary Sciences 8-01-90).
- 3098 REARING AND MAINTENANCE TECHNIQUES FOR MANTISPA VIRIDIS (NEUROPTERA: MANTISPIDAE) by J.R. Brushwein and J.D. Culin (Entomology 8-6-90).
- 3099 A NEW SPECIES OF FOSSIL DASYMUTILLA (HYMENOPTERA: MUTILLIDAE) FROM DOMINICAN AMBER by D.G. Manley and G.O. Poinar, Jr. (Entomology 8-06-90).
- 3100 AN IgA-LIKE SUBSTANCE IN THE CHICKEN'S PINEAL by I. Olah, and B. Glick (Poultry Science 8-06-90).
- 3101 CRYOPRESERVATION OF IPOMOEA BATATUS L.: PROTOCOL PARAMETERS NECESSARY FOR SURVIVAL FOLLOWING EXPOSURE TO -45 C by S.C. Weinst, S. Kadir and B.B. Rhodes (Horticulture 8-06-90).
- 3102 EFFECTS OF SEVERAL SELECTED ODORANTS ON THE Na⁺-K⁺ ATPase ACTIVITIES OF TWO DIFFERENT CHICKEN OLFACTORY TURBINALS by R.B. Kock, S. Smith and B. Glick (Poultry Science 8-07-90).
- 3103 REGISTRATION OF FIVE GERMPLASM LINES OF UPLAND COTTON WITH HIGH YIELD POTENTIAL AND FIBER QUALITY by C.C. Greene (USDA Agronomy and Soils 8-06-90).
- 3104 REGISTRATION OF TWO GERMPLASM LINES OF UPLAND COTTON WITH HIGH YIELD POTENTIAL AND FIBER QUALITY by C.C. Greene (USDA Agronomy and Soils 8-06-90).
- 3105 REGISTRATION OF FOUR GERMPLASM LINES OF UPLAND COTTON WITH EARLY MATURITY AND HIGH FIBER QUALITY by C.C. Greene (USDA Agronomy and Soils 8-06-90).
- 3106 EFFICACY OF DROUGHT-STRESSED WHOLE CORN PLANTS AS A FEED FOR RUMINANTS. II. EFFECT ON DIGESTIBILITY AND PERFORMANCE OF RUMINANTS CONSUMING WHOLE CORN PLANTS by D.L. Cross, V.J. Caldwell, and L.M. Redmond (Animal and Veterinary Sciences 8-07-90).
- 3107 NURSERY HOUSING SYSTEMS FOR EARLY-WEANED PIGS by D.L. Handlin, K.H. Lake and G.C. Skelley (Animal and Veterinary Sciences 8-07-90).
- 3108 USE OF ANABOLIC HORMONES IN MALE CATTLE: EFFECTS ON GROWTH, SERUM HORMONES, CARCASS COMPOSITION AND SENSORY CHARACTERISTICS by D.W. Hunt, D.M. Hendricks, G.C. Skelley and L.W. Grimes (Animal and Veterinary Sciences 8-07-90).
- 3109 EFFECTS OF PARASITISM ON HELICOVERPA ZEA (LEPIDOPTERA: NOCTUIDAE) PUPAL CELL CONSTRUCTION by J.D. Culin (Entomology 8-08-90).
- 3110 THE INTERACTION OF ALIPHATIC ACIDS WITH BASIC ALU-

- MINUM SULFATES IN FORESTED CECIL SOIL by A. Evans, Jr. (Agronomy and Soils 8-13-90).
- 3111 COMPOSTING BROILER LITTER-EFFECTS OF TWO MANAGEMENT SYSTEMS by S.T. Henry and R.K. White (Ag. Engineering 8-17-90).
- 3112 SPREAD AND PERSISTANCE OF BENOMYL-RESISTANT MONILINIA FRUCTICOLA IN SOUTH CAROLINA PEACH ORCHARDS by E.I. Zehr, J.E. Toler and L.A. Luszcz (Plant Pathology and Physiology and Experimental Statistics 8-22-90).
- 3113 BIOMASS, PRODUCTION AND TURNOVER OF HARD CLAMS, MERCENARIA MERCENARIA (L.), AT DIFFERENT DENSITIES AND TIDAL LOCATIONS by A.G. Eversole, J.G. Goodsell and P.J. Eldridge (Aquaculture, Fisheries and Wildlife 8-22-90).
- 3114 NON-LYMPHOID CELLS PRODUCE IgA-LIKE SUBSTANCE IN THE CORTICOMEDULLARY ZONE OF THE CHICKEN THYMUS by I. Olah and B. Glick (Poultry Science 8-22-90).
- 3115 SEASONAL HOME RANGE SIZE AND MOVEMENT BEHAVIOR OF THE GRAY FOX ON THE SAVANNAH RIVER PLANT by D.T. Sawyer and T.T. Fendley (Aquaculture, Fisheries and Wildlife 8-24-90).
- 3116 SEASONAL HABITAT USE BY THE GRAY FOX ON THE SAVANNAH RIVER PLANT by D.T. Sawyer and T.T. Fendley (Aquaculture, Fisheries and Wildlife 8-24-90).
- 3117 SPIDER (ARANEAE) TAXA ASSOCIATED WITH MANTISPA VIRIDIS (NEUROPTERA: MANTISPIDAE) AND AN ANALYSIS OF THE SPIDER ASSOCIATIONS OF MANTISPIDS IN THE CLEMSON AREA OF SOUTH CAROLINA by J.R. Brushwein, K.M. Hoffman and J.D. Culin (Entomology 8-24-90).
- 3118 EFFECT OF CLOMAZONE ON GROWTH OF TOBACCO (NICOTIANA TABACUS) CALLUS AND LEAF DISCS by S.K. McDonald, N.D. Camper and P.M. Burrows (Plant Pathology and Physiology and Experimental Statistics 8-24-90).
- 3119 ENHANCED BIODEGRADATION OF CARBOMOTHIOATES AFTER COLD STORAGE by McCuster, Skipper, et al (Agronomy and Soils 9-04-90).
- 3120 AMAYLASE GENE-ENZYME SYSTEM OF CHICKENS. II. BIOCHEMICAL CHARACTERIZATION OF ALLOZYMES by R.A. Gapusan D.G. Yardley, and B.L. Hughes (Biological Sciences and Poultry Science 9-06-90).
- 3121 EVIDENCE THAT FOLLICLE ASSOCIATED EPITHELIUM OF THE BURSA OF FABRICIUS IS NOT LYMPHOEPITHELIAL TISSUE by Imre Olah and Bruce Glick (Poultry Science 9-18-90).
- 3122 IMPACTS OF REDIVERSION ON THE SPAWNING UTILIZATION OF COOPER RIVER SYSTEM BY BLUEBACK HERRING by M.W. Thomas and A.G. Eversole (Aquaculture, Fisheries and Wildlife 9-19-90).

- 3123 ABUNDANCE OF LARVAL BLUEBACK HERRING IN SANTEE RIVER BEFORE AND AFTER REDIVERSION by C.J. Kempton, R.W. Christie, and A.G. Eversole (Aquaculture, Fisheries and Wildlife 9-19-90).
- 3124 ENDOGENOUS PEROXIDASE AND VIMENTIN POSITIVE CELLS ACCUMULATE AT THE CORTICOMEDULLARY BORDER OF THE CHICKEN THYMUS by Imre Olah, Cyndy Kendall and Bruce Glick (Poultry Science 9-24-90).
- 3125 LARVAL AND EARLY POSTLARVAL SHELL MORPHOLOGY OF SEVERAL VENERID CLAMS by J.G. Goodsell, S.C. Fuller, A.G. Eversole and R.A. Lutz (Aquaculture, Fisheries and Wildlife 9-24-90).
- 3126 THE EFFECTS OF AFLATOXIN B₁ ON INTERLEUKIN-1 PRODUCTION IN BOVINE MACROPHAGES IN VITRO by C.J. Walsh, A.B. Bodine and T.R. Scott (Dairy Science and Poultry Science 9-28-90).
- 3127 INFLUENCE OF PESTICIDES AND WEEDS ON PHYTOPHTHORA CINNAMOMI PRESENCE AND GROWTH by K. Kalmowitz, T. Whitwell, E. Zehr and J. Toler (Horticulture, Plant Pathology and Experimental Statistics 10-04-90).
- 3128 HISTORICAL PERSPECTIVES: THE UBRSA OF FABRICULUS AND ITS INFLUENCE ON B-CELL DEVELOPMENT, PAST AND PRESENT by Bruce Glick (Poultry Science 10-12-90).
- 3129 VIDESPREAD OCCURRENCE OF CONTIPEDEGRASS MOSAIC IN SOUTH CAROLINA by R.A. Haygood and O.W. Barnett (Plant Pathology and Physiology 10-15-90).
- 3130 REGULATION OF GENE EXPRESSION DURING FUNGAL DEVELOPMENT by Ralph A. Dean (Plant Pathology and Physiology 10-15-90).
- 3131 WEED IDENTIFICATION TRAINING IN AGRICULTURAL EDUCATION CLASSROOMS AND THE NEED FOR WEED SCIENCE AS AN INTEGRAL COMPONENT OF AGRICULTURAL EDUCATION CURRICULA by E.C. Murdock and G.S. Stapleton (Agronomy and Soils 10-25-90).
- 3132 CULTIVAR AND CALCIUM LEVEL INFLUENCE CALCIUM ACCUMULATION, CALCIUM DISTRIBUTION AND BIOMASS PARTITIONING IN COLLARDS by Jon Johnson (Sandhill REC 10-29-90).
- 3133 PERFORMANCE AND FECAL FLORA OF CALVES FED A BACILLUS SUBTILLA CONCENTRATE 1 by B.F. Jenny, H.J. vanDijk, and J.A. Collins (Dairy Science 10-30-90).
- 3134 DISTRIBUTION OF THREE RARE CRAYFISH SPECIES IN SOUTH CAROLINA by A.G. Eversole (Aquaculture, Fisheries and Wildlife 10-30-90).
- 3135 PLASMA CELLS EXPRESSING IgM AND IgA BUT NOT IgG DEVELOP AN INTIMATE RELATIONSHIP WITH THE CENTRAL CANAL'S EPITHELIUM OF THE CHICKEN'S HARDERIAN GLAND by I.

- Olah, T.R. Scott, M. Gallego, C. Kendall and B. Glick (Poultry Science 11-02-90).
- 3136 RESPONSE OF SPRING AND SUMMER-HARVESTED ASPARAGUS TO HARVEST PRESSURES by R.J. DuFault (Horticulture, Coastal REC 11-02-90).
- 3137 EVALUATION OF HOST SUITABILITY IN PRUNES FOR THE NEMATODE CRICONEMELLA XENOPLAX by S.W. Wescott and E.I. Zehr (Plant Pathology and Physiology 11-02-90).
- 3138 DEGREE DAY MODELS FOR EGG DEVELOPMENT AND REPRODUCTION BY CRICONEMELLA XENOPLAX by S.W. Wescott and P.M. Burrows (Plant Pathology and Physiology and Experimental Statistics 11-02-90).
- 3139 ACTIVITY OF THE BACTERIOCIN LACTACIN B IS ENHANCED DURING ASSOCIATIVE GROWTH OF LACTOBACILLUS ACIDOPHILUS N2 WITH LACTOBACILLUS LEICHMANNII ATCC 4797" by M.D. Hughes and S.F. Barefoot (Food Science and Microbiology 11-21-90).
- 3140 INFLUENCE OF END-OF-DAY LIGHT TREATMENT OF TRANSPLANTS ON GROWTH AND SUBSEQUENT YIELD OF TOMATOES by D.R. Decoteau and H.H. Friend (Horticulture 11-21-90).
- 3141 SEASONALITY AS RELATED TO EPIPHYTIC POPULATION OF XANTHOMONAS CAMPESTRIS PV. PRUNI ON PEACH AND PLUM by D.P. Shepard and E.I. Zehr (Plant Pathology and Physiology 11-21-90).
- 3142 ANTI-VIMENTIN MONOCLONAL ANTIBODY IDENTIFIES SECRETORY-DENDRITIC CELLS IN THE BURSA OF FABRICIUS OF THE CHICKEN by I. Olah, C. Kendall and B. Glick (Poultry Science 11-21-90).
- 3143 CONFINEMENT AND TRANSPORT-INDUCED STRESS IN RED DRUM FINGERLINGS: EFFECT OF SALINITY by C.R. Weirich and J.R. Tomasso (Aquaculture, Fisheries and Wildlife 12-13-90).
- 3144 GOSLING MORTALITY ON FARM PONDS by S.J. Huskey, T.T. Fendley and T.L. Ivey (Aquaculture, Fisheries and Wildlife 12-13-90).
- 3145 CANADA GOOSE NESTING BIOLOGY by S.J. Huskey, T.T. Fendley D.E. Baker and T.L. Ivey (Aquaculture, Fisheries and Wildlife 12-13-90).
- 3146 EFFECTS OF GRAZING OF SOFT WINTER WHEAT TO DIFFERENT PHYSIOLOGICAL MATURITIES ON GRAIN YIELD AND SOIL COMPACTION by M.A. Worrell, D.J. Undersander, and A. Khalilian (Animal and Veterinary Sciences 1-02-91).
- 3147 LARVAL AND EARLY POSTLARVAL SHELL MORPHOLOGY OF SEVERAL VENERID CLAMS by J.C. Goodsell, S.C. Fuller, A.G. Eversole M. Castahna and R.A. Lutz (Aquaculture, Fisheries and Wildlife 12-20-90).

- 3148 ROOT DISTRIBUTION IN A HIGH-DENSITY PEACH ORCHARD by J.C. Williamson and D.C. Coston (Horticulture 12-20-90).
- 3149 COMPARISONS OF METHODS FOR PREDICTING YEARLING SCROTAL CIRCUMFERENCE AND CORRELATIONS OF SCROTAL CIRCUMFERENCE TO GROWTH TRAITS IN BEEF BULLS by S.L. Pratt, J.C. Spitzer, H.W. Webster, H.D. Hupp, and W.C. Bridges, Jr. (Animal and Veterinary Sciences 12-20-90).
- 3151 BURMUDAGRASS PUTTING GREEN QUALITY AS INFLUENCED BY PERENNIAL RYEGRASS OVERSEEDING RATE by A. R. Mazur (Horticulture 1-16-91).
- 3152 RESEARCH NOTE: T-CELL ACTIVITY OF WHITE LEGHORN CHICKENS SELECTED FOR HIGH AND LOW ANTIBODY RESPONSES TO SHEEP ERYTHROCYTES by T.R. Scott, E.A. Dunnington and P.B. Siegel (Poultry Science 1-16-91).
- 3153 DOUBLE CROPPING INTERSEEDING SYSTEM FOR WHEAT, SOYBEANS AND COTTON by C.E. Hood, A. Khalilian, J.H. Palmer, T.H. Garner, T.R. Garrett and J.C. Haynes (Ag. and Biological Engineering and Agronomy and Soils 1-16-91).
- 3154 TOMATO SEEDLING GROWTH, EARLINESS, YIELD AND QUALITY FOLLOWING PRETRANSPLANT NUTRITIONAL CONDITIONS AND LOW TEMPERATURES by R.R. Melton and R.J. DuFault (Coastal REC and Horticulture 1-16-91).
- 3155 DEVELOPMENT OF AN EXPERT SYSTEM FOR SPRAYER DIAGNOSTICS by Y.J. Han, J. Boomaerts, S. Nugroho, C.D. Christenbury and F.J. Wolak (Agricultural and Biological Engineering 1-17-91).
- 3156 A COMPARISON OF SEVENTH INSTAR NYMPHS OF PERIPLANE-TA FULGINOSE (SERVILLE) AND PERIPLANTA AMERICANA (LINNAEUS) (DICTYOPTERA: BLATTIDAE) by Jill M. Gordon (Entomology 1-25-91).
- 3157 BURSAL SECONDARY DENDRITIC CELLS by I. Olah, B. Glick and C. Kendall (Poultry Science 2-07-91).
- 3158 DEVELOPMENT AND CONTROL OF A TIP BORER, OBEREA MYOPS IN RHODODENDRON by J.D. Culin and C.S. Gorsuch (Entomology 2-08-91).
- 3159 ORANMENTAL GRASS TOLERANCE TO POSTEMERGENCE GRASS HERBICIDES by Joanna Hubbard and Ted Whitell (Horticulture 2-19-91).
- 3160 MOVEMENTS AND HABITAT UTILIZATION OF TRIPLOID GRASS CARP IN LAKE MARION, S.C. by Samuel Chappelear, Jeffrey W. Foltz et al., (Aquaculture, Fisheries and Wildlife 2-21-91).
- 3161 PRODUCTION CHARACTERISTICS OF PAN-SIZE CHANNEL CATFISH IN CAGES AND OPEN PONDS by S.A. Davis, T.E. Schwedler, J.R. Tomasso and J.A. Collier (Aquaculture, Fisheries and Wildlife 2-22-91).

- 3162 COMPOSITION OF COUNTRY CURED HAMS COMPARING HOT BONING, COLD BONING AND INTACT HAMS by T.M. Moore, G.C. Skelley, D.W. Pilkington, E. Halpin, J.C. Alton and L.W. Grimes (Food Science, Animal, Dairy and Veterinary Sciences, and Experimental Statistics 3-01-91).
- 3163 SERUM HORMONE AND METABOLITE CONCENTRATIONS IN FASTED YOUNG BULLS AND STEERS by J.R. Ward, D.M. Hendricks, T.C. Jenkins and W.C. Bridges (Animal, Dairy and Veterinary Sciences and Experimental Statistics Depts. 3-05-91).
- 3164 MODIFICATION OF PROPERTIES OF EDIBLE WHEAT GLUTEN-BASED FILMS by A. Gennadios, C.L. Weller and R.F. Testin (Ag. and Biological Engineering and Food Science Depts. 3-06-91).
- 3165 NUTRITIONAL VALUE OF NAKED OATS (AVENA NUDA) IN LAYING HEN DIETS by Cau-Li Hsun and D.V. Maurice (Poultry Science 3-13-91).
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- 3167 THE EFFECT OF CYCLOPHOSPHAMIDE ON BURSAL AND SPLENIC DENDRITE CELLS by Judy Marsh and Bruce Glick (Poultry Science 4-02-91).
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- 3169 REGULATION OF DENDRANTHEMA X GRANDIFLORUM (RAMET.) KITAMURA GROWTH BY IRRADIANCE QUALITY by N.C. Rajapakse and J.A. Kelly (Horticulture 4-02-91).
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- 3173 A NEW SPECIES OF BLACK FLY IN THE SIMULIUM JENNINGSI GROUP (DIPTERA: SIMULIIDAE) FROM THE SOUTHEASTERN UNITED STATES by J.K. Moulton and P.H. Adler (Entomology 4-23-91).
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- 3178 LONG TERM PERFORMANCE POTENTIAL AND STABILITY ACROSS 19 ENVIRONMENTS FOR NINE APPLE ROOTSTOCKS TESTED IN THE 1980/81 NC-140 TRIAL by W.C. Olien, D.C. Ferree, and B.L. Bishop (Horticulture — CU; Horticulture — Ohio State; and Statistics Laboratory — Ohio State 5-01-91).
- 3179 COMPARISONS OF GLUTATHIONE S-TRANSFERASE ACTIVITY IN THE RAT AND BIRDS: TISSUE DISTRIBUTION AND ULTRADI-AN VARIATION IN CHICKENS (*GALLUS domesticus*) by D.V. Maurice, S.F. Lightsey, H. Kuo-Tung and J.F. Rhoades (Poultry Science 5-03-91).
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- 3183 SEASONAL EFFECTS ON CAPRINE RESPONSE TO SYNCHRONIZATION OF ESTRUS AND SUPEROVULATORY TREATMENT by B.J. Senn and M.E. Richardson, (Animal, Dairy and Veterinary Sciences 5-24-91).
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- 3188 PRODISSOCONCH I AND II LENGTH IN MERCENARIA TAXA by J.S. Goodsell and A.G. Eversole (Aquaculture, Fisheries and Wildlife 6-06-91).
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- 3190 SANITARY EVALUATION OF TARGET FLOWMETER USED IN A DAIRY PROCESSING PLANT by A.K. Greene, T.G. Reynolds and E.M. Southerland (Animal, Dairy and Veterinary Sciences, and Agricultural Products Sales 6-11-91).
- 3191 LUTEAL FUNCTION AND REPRODUCTIVE RESPONSE IN SUCKLED BEEF COWS FOLLOWING METESTRUS ADMINISTRATION OF SYNCRO-MATE-B WITH VARYING DOSAGES OF INJECTABLE NORGESTOMET by M.D. Danning, J.D. Spitzer, G.L. Burns and B.B. Plyler (Animal, Dairy and Veterinary Sciences 6-11-91).
- 3192 WATER ACTIVITY PREDICTION FOR YELLOW DENT CORN by C.L. Weller and L.K. Johnson (Agricultural and Biological Engineering 6-19-91).
- 3193 PREMATURE DEATHS, INCOME AND RACE IN THE RURAL SOUTH by K.R. Bowman and C.O. Nyankori (Agricultural and Biological Engineering 6-20-91).
- 3194 EFFECTS OF NuSERUM R ON IN VITRO CULTURE OF MURINE EMBRYO by B.J. Senn, M.E. Richardson, J.F. Dickey and L.W. Grimes (Animal, Dairy and Veterinary Sciences, and Experimental Statistics 6-24-91).
- 3195 TECHNIQUES FOR DETECTING GRASS TOLERANCE TO SETH-OXYDIM AND FENOXAPROP-ETHYL HERBICIDES by J. Hubbard and T. Whitwell (Horticulture 6-25-91).

COOPERATIVE EXTENSION SERVICE

As the educational outreach arm of the University Division of Agriculture and Natural Resources, the Cooperative Extension Service provides information and statewide continuing education programs that can make life easier and more enjoyable for every South Carolinian. The programs cover 16 disciplines relating to agriculture and natural resources, home economics, 4-H and youth development, and community development. In addition to general education information, special programs are included for limited-resource farmers and the economically disadvantaged.

Funded by federal, state and county governments, the Extension Service was created in 1914 as a nationwide system designed to carry education from land-grant universities to the people. For 77 years, Extension has worked closely with South Carolinians helping them build a better life through dissemination of practical, useful information within its assigned areas of responsibility.

Originally conceived to help rural people, Extension responded to the changing needs of those it served by broadening its scope of activities to include urban and suburban problems.

Clemson, through its Extension Service, maintains an office manned by agents in each county. A professional staff of Extension subject-matter specialists at the University and four Research and Education Centers around the state compiles information from research and translates it into information the people of South Carolina can use day-to-day.

From basic nutrition information to irrigation field tours, Extension staff members and volunteers are teachers carrying University educational programs to all areas of the state.

The Extension program is organized around these broad categories: agriculture and natural resources (including special programs for limited resource farmers), 4-H and youth development, home economics (including the Expanded Food and Nutrition Education Program), community development and 1890 programs conducted by S.C. State College, in cooperation with the Clemson Extension Service.

As part of its four-year planning cycle, the Clemson Cooperative Extension Service has developed a new plan for program delivery through the mid-1990s. Nearly 1,000 South Carolinians helped Extension identify major problems facing the state and prepare a new plan to address those problems. In addition, Extension's four-year plan outlines educational activity for base and mandated programs related to its mission.

The plan, drawn up in 1990 and 1991, was developed in concert with the S.C. State College Extension Program. Already it is guiding the development and implementation of Clemson Extension educational programs in such areas as water and food quality, management of other natural resources and youth development.

The Clemson Extension plan of work, which meshes well with the University's strategic plan on the environment, identifies and addresses issues of concern to a broad spectrum of the state's population.

In putting it together, Extension's state staff studied the latest demographic information on the area. Situational statements were compiled by Extension faculty members on campus and in Clemson Extension offices in each county.

These statements were reviewed by priority identification committees in every county in the state. These committees were made up of a cross section of local county residents. Statewide, more than 750 people served on these committees.

They met, identified local educational needs, and prioritized them. Those needs related to Extension's mission were consolidated at the state level.

The list was studied by members of the State Extension Advisory Council and a team of 22 Extension professionals. They recommended nearly 100 items to include in the plan of work.

From among the issues identified, priority will be given to six statewide issues:

- Natural resources management;
- Food quality, safety and nutrition;
- Profitability and sustainability of agriculture;
- Waste management by industry (including agriculture), municipalities and consumers;
- Water quality; and
- Youth at risk.

Five of these six statewide thrusts have the environment at the center of their focus. The plan includes 33 educational program thrusts for agriculture and natural

resources, 22 for home economics, 14 for youth development and four for community development.

Advancing Agriculture and Natural Resources Management and Technology

Agronomic Cropping Systems

The Agronomic Cropping Systems Thrust Team provides leadership in a major effort to improve profits from production of field crops, minimize the impact of crop production on the environment and ensure production of healthy and nutritious food and fiber. Informal teaching efforts bring current technology and information on crop production to growers and the agricultural community.

Commodity specialists provide the educational information on production, processing and marketing. However, County Extension agents are key components of the Agronomic Cropping System educational delivery.

In 1990 field crops accounted for more than 86 percent of the South Carolina crop income, with the major crops being tobacco, corn, soybeans, cotton, peanuts, wheat and forages. Potential new crops being grown on a limited acreage are flax, canola, triticale and kenaf.

Doublecropping in wheat production is becoming more important to farm income each year. Canola also offers a doublecropping opportunity that may grow in importance. Extension efforts to increase the profitability of doublecropping involve conservation tillage, interseeding soybean and cotton in wheat, cultivar selection, fertilization and pest management. Extension's documentation of Hessian fly damage and development of a management program has resulted in wheat yield increases of up to 40 bushels per acre during heavy fly infestations.

Forage production and management demonstrations are providing information for educational programs on grazing management. Improved use of forage and efficient livestock production are goals of this activity. The forage publications, demonstrations, producer meetings and video tapes are used to educate producers and other clientele.

Profitability of crop production is enhanced by reducing inputs without lowering yield potential. Educational programs stress identification of problems and use of production practices to manage these problems. Scouting programs that teach clients to identify insect pests and damage levels are conducted annually. Addition of fertilizer based on soil testing is emphasized in educational programs. Weed identification and infestation levels are used as a basis for herbicide selection, if needed. Nematode thresholds are used to determine if a nematicide is needed or if resistant cultivars are more cost effective. Pesticides are recommended only when required for management of the pest problem. Band application of herbicides will reduce the amount applied in many situations. These techniques help reduce the total amount of pesticide being introduced into the environment and increases grower profit.

Field meetings on cotton plant mapping and physiology help growers manage production of the crop. Time-critical practices and crop progress evaluation are much more accurate when growers use these techniques.

Collaboration between the Clemson Extension Service, the Soil Conservation Service, the Land Resources Commission and the S.C. Department of Agriculture serves to promote the agricultural economy of South Carolina, while stressing environmentally sound programs that will assure the long-term sustainability of production agriculture in the state.

Aquaculture, Fisheries and Wildlife

During this past program year the Clemson Extension wildlife program centered around five major programming areas:

- Integrated farm, forest and wildlife management;

- Economic impact of wildlife on rural communities;
- Youth education in wildlife and natural resource management;
- Wildlife damage control; and
- Conflict resolution in issues regarding the use and management of wildlife.

Audiences targeted for instruction in these areas included Extension agents, natural resource professionals, landowners, sportsmen and the general public. Five week-long short courses, "Wildlife and Forest Management for Profit and Recreation," were held around the state for landowners and natural resource professionals. These short courses provided in-depth "hands-on" experience for land owners to maximize the productivity of their lands for both wildlife and timber through an integrated land management approach. Evaluations from the short courses indicated that more than 500,000 acres of private forest and agricultural land were represented, and that participants indicated the short course instruction had the potential to save or make them a total of \$400,000.

According to estimates, wildlife-based recreational activities generate more than \$800 million in this state. Further estimates suggest that a large portion of this revenue may be spent in rural counties during hunting season. Preliminary results from a study conducted by the Clemson Extension wildlife program in Jasper and McCormick counties to determine the economic impact that hunting has on the county level indicates that hunting contributes significantly to the local county economy. Information in this study will help identify additional opportunities for private landowners and businesses to capitalize on current wildlife recreation in their communities, as well as identify needs to be addressed by economic development groups.

Youth education in wildlife and natural resource management has expanded under the new 4-H wildlife habitat evaluation program. Young people, aged 10 through 18, from across the state trained and competed for state recognition this year. The winning team represented South Carolina in the national contest in North Dakota. The 4-H wildlife habitat evaluation program is part of a larger environmental education program for youth coordinated by Clemson Extension Service and supported by private funds.

The Clemson Extension wildlife program also is working to reduce the extent of economic damage (agricultural and residential) caused by nuisance wildlife. Crop damage by deer continues to be a problem agricultural producers face. Extension wildlife has initiated a new effort to examine the extent and economic damage that deer have on the agricultural community. A 10,000-acre demonstration project is being established to serve as a model to illustrate effective methods of reducing crop damage by deer. This project also is expected to reduce deer-vehicle accidents at the same time.

The use and management of wildlife in the state is and will continue to be a controversial issue among user and special interest groups. As a result the Clemson Extension wildlife program has become proactive in its efforts to supply the public with unbiased, factual information upon which sound decisions can be made and information that hopefully will circumvent or resolve potential conflicts in the future.

Extension aquaculture has been the leader in the dramatic expansion of South Carolina catfish production. The expansion has been so successful that fish on about 1,700 acres of ponds are worth about \$25 million to the state's economy.

The Hampton Aquaculture Demonstration Center has helped the commercial catfish industry establish about 1,000 acres of stocked ponds. A 60,000-pound per day processing plant has been built in the Hampton area to process catfish. Fingerlings grown at the Clemson facilities have been stocked in 95 4-H projects throughout the state as well as home food production demonstrations. Marion County has emerged as a new aquaculture center for South Carolina, with 220 acres in production and a seven million fish per year hatchery.

Dairy Management

South Carolina dairy farmers continue their admirable record of efficiency in milk production. Milk production increased from 43 pounds per cow per day in 1980 to 52 pounds in 1990 (SCDHIA).

In 1980 there were an estimated 2,000 farms with one or more dairy cows in South Carolina with an average of 48,000 milk cows producing 541 million pounds of milk. In 1990 there were an estimated 1,200 farms with one or more dairy cows in South Carolina with an average of 35,000 milk cows which produced 446 million pounds of milk.

Gross milk sales at the farm level was \$73.5 million. Added to the cash value of milk is about \$6 million for cull cows, \$1 million for sale of bull calves and \$1.5 million for sales for dairy purposes, bringing the total receipts for dairy farms to more than \$81 million. Fourteen counties in South Carolina had milk sales of more than \$1 million in 1990. Newberry surpassed Orangeburg as the leading dairy county in the state with sales of \$12.8 million, compared to \$12.2 million in milk income for Orangeburg county.

Dairy farming in South Carolina continues to suffer through the depressed farm milk prices which have caused serious financial distress on most dairy farms in the state. As a result, Extension's Dairy Thrust Team has concentrated on milk marketing during the past year. Numerous dairy meetings were held during the year to discuss available alternatives on milk marketing proposals. Meetings with dairy producers in Greenville and Columbia established the momentum for establishing the Southeastern Dairy Farmer Federation (SDFF), an organization that will bargain for higher milk prices for its member producers in 10 Southeastern states. In June, South Carolina dairy producers became the first to join the SDFF. The federation's leaders continue a membership campaign, targeting more than 10,000 producers in the Southeast.

In addition to dairy marketing, Dairy Extension programs in South Carolina continue to emphasize computer balanced least cost feeding programs. This is achieved by using Dairy Herd Improvement records through computer analyses and milk management. South Carolina's 205 Grade A dairies average more than 160 milking cows with gross income of nearly \$400,000 per pound.

As a result cash flow analyses and budget analyses continue to be emphasized by Dairy Extension personnel. A project on the cost of producing milk in South Carolina dairy herds was conducted for the second straight year. This project supplies valuable data for educational programs with involved dairy producers and the dairy industry.

Forestry Management Systems

Forestry is the third largest industry in South Carolina and Southern pines represent the largest cash crop in the state. Recently the pine harvest has generated more than \$500 million in yearly cash receipts — nearly equivalent to the value of all other agricultural crops combined.

In 1989 South Carolina forests were severely damaged by Hurricane Hugo. As a result more than a million previously forested acres will require some form of reforestation to restore the state's wood supply to previous levels. Extension forest resources has secured a three-year grant of more than \$300,000 to develop educational materials and programs that will help landowners in this effort.

During the past year mass mailings and brochures were used to inform landowners of the many reforestation options and opportunities available to them through the S.C. Forestry Commission. In response, about 1,100 landowners representing more than 300,000 acres of damaged forest lands contacted the commission for assistance.

Workshops on regeneration technology specific to storm-damaged lands were held to train professional foresters who are providing reforestation assistance. A tax workshop was presented to about 110 professional foresters, tax advisors and land-

owners to inform them of tax incentives to assist in reforestation and methods of reinvesting casualty income into forest land.

While educational efforts directed at reforesting storm-damaged lands progressed, Extension forest resources also was successfully positioning itself for the future. Federal grants were obtained for projects of national importance. These grants include \$32,000 for activities in the Forest Stewardship Program and \$11,400 to develop materials and train professionals for the urban tree planting and maintenance portion of the "America the Beautiful" program. An additional grant of \$30,000 was obtained from the USDA Extension Service to inform community officials and train tree care professionals about the existing and future hazards and liabilities of storm-damaged urban trees in the Hurricane Hugo affected area.

The continuing education program for professional foresters also continues to expand. More than 500 foresters and other professionals attended all seven programs offered in 1991. The overall Extension forest resources program is beginning to provide timely technical and policy-oriented information to foresters in this state and region.

Home Food Production

Home food production is important to South Carolinians who relate it to nutrition, family budgeting, leisure time activities and agribusiness as well. Sixteen Clemson Extension specialists from five University departments and 98 agents from 40 counties are participating in the program.

Accomplishments in the home food production area for the year (as reported by 40 counties, the Horticulture and Entomology departments and the Extension home food production program team) include:

- 11,642 families received information on home food production.
- 2,022 families supplemented their diets and budgets with home-grown plant and animal foods.
- 2,779 people were trained in pesticide management and safety (up 29 percent over the previous year).
- 1,665 4-H youth were involved in activities to develop home food production skills.
- 1,232 families marketed home-grown foods directly through local and state farmers markets, contract sales, pick-your-own markets.
- Eight garden grants of \$250 each were awarded to community gardens, 4-H clubs and schools in eight counties.

Horticultural Crops Management Systems

Statewide Extension programs in ornamental crops focused on increasing awareness concerning water quality and alternatives in pest control methods for nursery growers.

A two-and-one-half-day short course in Columbia was attended by more than 1,000 nursery industry people. The study manual for the Professional Certification Program, sponsored by the S.C. Nurseryman's Association, was completely revised and updated this year.

An integrated pest management program for the nursery industry is under way. As part of the project three Upstate nurseries are being scouted on a regular basis so that IPM strategies may be implemented. The program has reduced successfully the number of chemical pest control sprays and the money spent purchasing chemicals used in conventional methods.

A new greenhouse manager and floriculturist has joined the Extension staff, helping in the planning, organizing and implementation of the 1991 Greenhouse Growers' Short Course and Trade Show. This event drew more than 470 people interested in the greenhouse industry in the Southeast. Most of the participants (62 percent) were from South Carolina. Specific areas emphasized in this year's program were: 1) Integrated Pest Management (IPM) principles and practices for the

greenhouse industry; 2) scheduling and cultural information for major greenhouse crops; and 3) new greenhouse technologies leading to increased profit.

Acreage devoted to vegetable production in South Carolina has decreased over the last 50 years. Inefficiency, low yields and a reputation for poor quality all have contributed to the acreage decline. Drip irrigation, fertigation and the use of plastic mulches can improve yields and quality.

Twelve new vegetable enterprises were initiated with varying degrees of success. Numerous potential growers were discouraged from entering vegetable production due to managerial limitations or lack of market access. More than 500 acres of oriental vegetables were grown this past spring because of Extension activities. The use of plastic mulch and row covers has increased 15 and 50 percent, respectively, through successful demonstrations. The state's largest pre-packer of fresh vegetables reduced product losses by more than 50 percent using Extension-related research findings.

With the help of Extension, industry made the following accomplishments:

- The establishment of a cold room by a melon grower has greatly improved the ability of growers to market high quality melons and increased returns to the grower by \$87,000.
- Increased use of mulch resulted in increased returns of \$127,000 and reduced post-harvest losses resulted in savings of \$223,000 for growers and shippers.

Post harvest quality and losses were evaluated through adjustments to prices and through federal inspection certificates for shipped products and through on site inspection of local markets. Success of new vegetable enterprises was determined by monitoring over the last two years.

Land and Water Resources

Two major efforts dealing with water quality issues were initiated last year. The first was part of the national Extension initiatives on water quality dealing with critical hydrologic units. An on-going program in Newberry, Lexington and Laurens counties and a new program in Spartanburg target management of animal waste, soil erosion and sediment loading from agricultural, urban and construction activities. A newsletter in the counties is being sent out covering information on the hydrologic unit.

The "TAP," Teaching Aquifer Protection, in-school enrichment curriculum was developed for youth grades four through six. The program teaches elementary school students about various water quality issues. TAP is made up of six units: Introduction to Water, The Water Cycle, Ground Water, Water Pollution, Recycling Water and Making a Difference — Our Responsibility. A training program is set up to introduce teachers to the material before they use it in the classroom.

Water conservation training was conducted for Extension agents in coastal counties where critical water quality and quantity problems exist. This training emphasized ways of reducing residential and commercial water use. The use of xeriscaping as a new technique to reduce water requirement and yet maintain a good looking landscape on the East Coast was presented.

Extension specialists also made available to farmers in the state information on the regulations dealing with underground storage tanks. The information included highlights from EPA and DHEC publications. The information also dealt with the problems associated with leaking tanks, possible ground water contamination and methods for using above ground tanks.

Livestock Management Systems

Marketing plays a key role in the success of farm produced products. Unfortunately there are very few individuals who will work long and hard enough to establish new markets. One successful market in South Carolina for the beef industry,

developed over the past few years, is the "Commercial Replacement Heifer Sale" at Clemson University. Quality female cows, heavy enough to be cycling and capable of breeding immediately after the sale, are sold each February in conjunction with the existing performance tested bull sale.

Summary – Replacement Heifer Sale

| Year | No. Lots | No. Herd | Total Weight/lbs. | Average Weight/lbs. | Total \$ | Average/Head |
|------|----------|------------|-------------------|---------------------|---------------|--------------|
| 1988 | 21 | 73 | 54,889 | 752 | \$ 44,855 | \$614 |
| 1989 | 32 | 112 | 88,334 | 788 | 82,940 | 740 |
| 1990 | 41 | 143 | 109,118 | 763 | 105,490 | 738 |
| 1991 | 30 | <u>125</u> | <u>98,293</u> | <u>786</u> | <u>97,400</u> | <u>779</u> |
| | | 453 | 350,634 | 774 | \$330,685 | \$730 |
| | | total | total | average | total | average |

The information in Chart 1 clearly shows a continued interest among consignors to market their replacement heifers through the sale. The increase in weight indicates that cattlemen have adopted better management practices, and they now know that heavier heifers demand additional dollars. Price is influenced by market trends based upon supply and demand. Calculations show the above listed heifers brought about \$200 per head above the market price on the day of the sale. Because of this "value added" advantage for good replacement heifers, some 400 additional heifers are being sold at the farm by private treaty, and the price is based upon the average of the replacement heifer sale at Clemson.

Looking at this new market, the cattle sold there annually and the 400 additional heifers sold at home with the \$200 per head "value added," that's an additional \$102,600 annual income, above the going market value, for replacements. Over the past four years, that has amounted to additional income of \$410,400.

In addition to the extra income South Carolina has established the new replacement heifer market and a reputation among neighboring states for good replacement females. Local cattlemen now are better managers, have adopted herd health programs, have learned about and adopted crossbreeding systems and realize that a slight improvement in the quality of product produced can add value in the market place.

Marketing, Packaging and Utilization

Farm income can be effectively increased by providing farmers and producers with the technology to add value to their products. To enhance farm income during the 1990-91 program year, Extension food scientists conducted the following activities:

- A fruit and vegetable retail packaging workshop presented to 16 producers of the Foothills Marketing Association of S.C.;
- In-service training for 11 Extension agents on the proper use of modified atmosphere packaging techniques to extend the shelf-life of fresh fruits and vegetables;
- Initiation of a packaging materials database for rapid computer selection of commodity-specific, on-farm packaging system(s);
- Eight technical hydro-cooling advisories to improve tomato and peach packing efficiencies; and
- Compliance advisories provided to 18 producers regarding the proper labeling of waxed fruit and vegetables.

Except for fresh fruits and vegetables, all other food products grown or harvested in South Carolina must be processed and packaged. The South Carolina food

processing industry converts approximately \$1 billion of agricultural commodities into processed and packaged food products having a retail value of more than \$3 billion. Consequently, it is essential that both the state's farm producers and processors maintain a viable agribusiness liaison with each other. To foster this liaison and to promote a continuous flow of a wholesome and marketable supply of South Carolina food, Extension food scientists and specialists provided educational program training and advisories with the following accomplishments:

- More than 1,200 employees and managers received short course training in the principles of Total Quality Management (TQM) and Statistical Process Control (SPC). Techniques learned by the participants enabled them to help their companies improve product quality and productivity for increased profits.
- More than 15 food processor employees received FDA certification training in commercial food sterilization and packaging. The training allowed one company to fulfill a \$64 million defense contract vital to the success of Desert Shield and Desert Storm.
- More than 125 on-site advisories to more than 40 South Carolina firms were conducted to promote the adoption of numerous food processing and packaging technologies. The advisories helped the firms introduce new food products, improve packaging systems, decrease operating costs, increase operating capacity, improve product quality and decrease or eliminate discharges.
- More than 15 technical reports were developed that resulted in the introduction of three new food products that had a retail value of more than \$500,000 per year.
- More than 80 food regulation memorandums were disseminated to more than 6,450 processor contacts to promote awareness of changes in federal and South Carolina food laws.
- More than 400 general advisories were provided in response to South Carolina inquiries on various aspects of food safety, preservation, packaging, labeling or starting a commercial food venture.

The University's Extension food science programs and personnel are dedicated to the development and delivery of educational activities that foster the profitable production and processing of South Carolina commodities into a safe, wholesome and nutritious supply of food.

Farm Management, Marketing and Agricultural Policy

- Using the Clemson Video Teleconference Network, training was held for county agents, producers and government agencies on the content, likely impacts and implications of the 1990 Farm Act.
- More than 160 people participated in the 10th Annual S.C. Agricultural Outlook and Policy Conference. This Conference highlighted price forecast and management strategies for major South Carolina commodities and products.
- Computer software was developed and distributed to assist farmers with making decisions about participation in the various alternatives of the 1990 Farm Bill. County Extension agents prepared more than 500 analyses for producers.
- A new farm management association was begun in Orangeburg, Calhoun, Bamberg and Hampton counties. The association is off to an excellent start, with several farmers on the waiting list for membership in 1992.
- Sixty enterprise budgets of row crops, vegetables, fruits and livestock were developed and distributed to farmers and agricultural lenders to be used for farm and financial planning. The budgets are used extensively by farmers and lenders.

- "Intellibanc," a computerized international market research system, was demonstrated to trade facilitation agents and small businesses for a year through three county Extension offices. "Intellibanc" provides trade leads for businesses wanting to export their products.
- Livestock-forage economic programs with an emphasis on sustainable agricultural systems were presented to small and part-time farms. The programs included presentations on improved grazing management, agroforestry and the use of small ruminants. A grant to study the marketing structure of goats produced in the South also was obtained.
- Six income tax schools were conducted for 825 tax practitioners. The schools focused on new tax law changes. A workbook was prepared on discharge of indebtedness procedures.
- Farmer marketing clubs were started in Lee, Clarendon and Williamsburg counties. Clubs already have been organized in Orangeburg, Calhoun and Sumter counties. The objective of the marketing clubs is to improve the marketing skills of farmers and other agribusinesses.
- Newsletters and outlook updates were prepared for fruit and vegetable producers to assist them in making marketing decisions. Special emphasis was given to evaluating the North American Free Trade Agreement and its impact on South Carolina producers.
- Financial management and marketing assistance on aquaculture was provided to farmers. Acres of ponds in catfish production have more than doubled from 800 to 1,700 acres since 1989. In addition, an \$8 million integrated South Carolina clam operation was started in 1991.
- The Simplified Farm Record System was improved and expanded with the assistance of a USDA grant. This program concentrates on small farm recordkeeping, filing procedures and business analysis. Fourteen 1862 and 1890 Extension agents received intensive training. This two-day training was enhanced by participation of home economics and FmHA personnel. Nearly 400 small farm units participated in the program.

Agricultural and Biological Engineering Department

Energy audits were completed on 58 greenhouses last year, bringing the total during the past two years to 158. Seventy additional audits were completed on fruit and vegetable cooling facilities, bringing the total to 95 for the past two years. Potential energy savings from these audits could range from 10 to 20 percent.

Energy audits were continued on irrigation pumping units, bringing the two-year total to 29. The average efficiency of all the pumping units selected at random equaled 82 percent of the reported standard. This 82 percent equates to a pumping plant performance of 0.73 whp-hr per KWH. If all pumping units were the same as the standard, farmers could realize a savings of 6.48 KWH per acre inch of water applied through a sprinkler irrigation system. This would equate to a potential savings of 7,128,000 KWH of energy in South Carolina.

An energy audit workshop was conducted for extension agents and others interested in energy savings. This workshop covered greenhouse and vegetable cooling, irrigation pumping plants, farm facilities and tractor testing.

A project was initiated to demonstrate vegetable cooling technologies for South Carolina fruit and vegetable growers. Cooperation continued on the development of a multi-pass cucumber harvester. Plans for a low-cost evaporative cooler for fruit and vegetables have been distributed by request to nearly 300 people worldwide.

A demonstration of under-bench heating in greenhouses was continued and was the basis for the new publication "Root Zone Heating for South Carolina Greenhouse Growers."

Information on available Extension plans was better distributed this year through the production of the "Horse Facilities Plans" book and a publication supporting the Forest Stewardship program.

Progress was made in the area of swine production, with efforts centered

around the small producer. Extension continues to provide plans for portable swine housing facilities and to update and disseminate the latest best management practices for farm structures and animal waste to protect water quality.

Extension agricultural and biological engineering has helped in the sorting and storage of recyclable household waste products to conserve space in residences. Educational efforts have included plans, space need specifications, pest control measures, compostables, handling, etc., as a beginning effort in an expected long-range process of new habits that will be developed in all homes.

The S.C. Youth ATV safety Program began in conjunction with the 4-H department. More than 1,000 youth have received ATV safety education and parent groups will be targeted this fall.

Farm accident rescue training was offered to several EMS groups and farm safety training was given at several locations, including the USDA Vegetable Laboratory and at vocational agricultural instructors meetings. Work was begun with the DHEC Child Injury Prevention Project and the AHEC Healthy Harvesters migrant project to include farm safety information in those programs.

The 4-H "Get Fired Up!" fire safety program continues to educate more than 20,000 fourth through sixth grade students throughout South Carolina. This program offers new material designed for teachers to use in classrooms with the help of local 4-H agents and fire professionals. A K through first grade pilot program will be implemented next year.

The Agricultural Weather Office prepares weather forecast tables which are posted daily on the CUFAN system. Climatological information developed from records maintained by the office was supplied to users upon request. Weekly summaries of evaporation and soil temperatures were used in the USDC/USDA Weekly Weather and Crop Bulletin.

The University Housing Institute, a multi-discipline unit, made available grants of about \$2,000 each to several Clemson Extension offices and to several departments on the Clemson campus to carry out demonstration and education programs. These programs ranged from building displays for home shows to providing travel to and from meetings. The Housing Institute has been reorganized and is on the way to achieving its goals. Last year the following projects were funded:

- Emerging Housing Environmental Issues — Water Usage/Radon — Lexington and Richland counties;
- Say Yes to a Healthy House: Preventive Measures for Home Moisture Problems — Abbeville;
- Portable "Moisture Control in Housing" Kit — Newberry County;
- Plan, Promote and Sponsor Seminars Related to Consumer Needs in Housing, Home Financing and Home Maintenance — Florence;
- Housing Education (wood moisture meter) — Chester County;
- Identifying, Preventing and Correcting Moisture Problems in the Home — Bamberg County;
- Public Housing Orientation for Limited Resources Families — Greenville County;
- Moisture in Housing Due to External Sources — Campus;
- Five Educational Leaflets to Coordinate with Five VHS Tapes — Campus;
- Transparent Curing Oven for Thermosil — Campus;
- Improved Clay Roofing Tile — Campus;
- Price Level Adjusted Mortgages: Demonstrating How They Work Under Different Scenarios of Actual Inflation — Campus; and
- The Effect of Wind Shelter on the Performance of Non-Engineered Housing Structures — Campus.

Agronomy Department

Extension agronomists have implemented educational programs addressing issues of major concern regionally, nationally and globally. The issues addressed in-

clude water quality, food safety, waste management and the short- and long-term ecological and economic sustainability of agriculture in South Carolina.

Such issues impact our entire population. Educational programs targeted toward agricultural producers will allow rapid and significant technology transfer to ensure our success in preventing or minimizing undesirable environmental effects associated with agricultural production practices.

A database is being established to determine our present environmental situation and subsequent changes in production practices needed to maintain or improve water quality. Reducing agricultural chemical (fertilizers and pesticides) inputs also is a major area of concern.

The University's Agricultural Services Laboratory has been used extensively by growers to guide the use of plant nutrients to ensure adequate production levels with minimal environmental impacts. Herbicides account for 80 percent of agricultural pesticides used in the state. Educational programs have emphasized utilization of cultural, mechanical and biological weed management practices to minimize dependence upon herbicides.

Also, intensive educational efforts covering weed identification, herbicide efficacy and crop and weed responses to herbicides have encouraged judicious use of herbicides to preclude unnecessary applications, over-application or unacceptable weed control. Our waste management programs have emphasized economically and environmentally sound application of wastes based upon nutrient content. To effectively deliver this information, on-farm demonstrations and tests, county or multi-county meetings, statewide meetings, tours and field days, and training sessions have been conducted. Total clientele exceeded 2,500 growers, agribusiness representatives and other agriprofessionals.

The welfare of our agricultural economy depends on profitability, which is driven by production levels, quality of the final product and effective marketing. Cash receipts from South Carolina's agronomic crops exceed \$380 million/year, with the majority (95 percent) obtained from tobacco, soybeans, corn, cotton and wheat. Therefore, Extension agronomy programs emphasize economically and environmentally sound production systems for these crops.

Variety selection, pest management, nutrient management, tillage systems and rotations have received considerable attention in our efforts to help growers achieve profitable production levels. Extension agronomists have conducted relevant applied research to provide timely and scientifically sound recommendations. These efforts target specific production problems encountered in South Carolina and are an essential component of a responsive and effective Extension program.

In addition, extensive efforts have centered around the possibility of successfully producing alternative agronomic crops in South Carolina. Extension agronomists published several production guides for new crops and have conducted on-farm demonstrations, production meetings, applied research projects and statewide tours and field days to provide growers with information concerning successful production of canola, flax and triticale in South Carolina.

Extension agronomy's educational programs have enhanced the ability of our growers to remain competitive in the agricultural system and have helped ensure the long-term sustainability of agriculture in South Carolina. We are looking toward the future, when rapid transfer of advanced technology to the agricultural community will be critically important in addressing major agricultural and environmental issues.

Entomology

Five years ago most South Carolina wheat producers had never heard of a pest that was costing them more than \$2 million a year. Wheat profitability in South Carolina and much of the Southeast is now known to depend on management of that key economic pest, the Hessian fly.

Growers historically went through cycles of high wheat yields followed by dramatic yield decreases. These yield collapses were often attributed to "winter kill" or

lack of vernalization. Subsequent surveys by Clemson Extension entomology specialists demonstrated annual infestation levels of Hessian fly that were higher than previously documented in any state. Subsequent grower education programs, evaluation of resistant wheat varieties and on-farm demonstrations have been used to develop an overall management program which includes the recommendation of three varieties with high levels of resistance.

About 40 percent of the state's wheat acreage now is planted with resistant varieties. Field tests and demonstrations of insecticidal treatment on high yielding, but susceptible varieties, resulted in dramatic yield increases of as much as 40 bushels per acre under heavy infestation levels. Cultural control demonstrations have been used to show the importance of eliminating sources of infestation such as volunteer wheat from fallow fields and dove hunts. This effort also has documented the pest's multiple generation life cycle in South Carolina.

Producers now are able to identify this pest and its symptoms in the field and how to manage it. A 1990 survey of Coastal Plain wheat producers showed that more than 90 percent of respondents had received information needed to change management practices on their farm. This program also received the National Alliance of Wheat Growers 1990 Excellence in Extension Award.

A major service Extension entomology provides the state of South Carolina is the accurate identification of insects and related arthropods. This year there has been 143 percent more samples (about 700) submitted for identification than in 1990. Based on average costs charged by identification units in some areas of the United States and England, this service is worth more than \$35,000. The samples come from a wide range of sources. It may simply be a homeowner wanting to know what some strange looking insect is. Samples also are submitted by County Extension agents wanting to identify an unfamiliar insect that has been found on a crop. In some cases the unidentified insect may prove to be harmful and must be controlled. At times, samples must be forwarded to specialists at the USDA offices in Beltsville, Md., for more complete identification.

Horticulture Department

Horticulture sponsored a record number of grower education programs last year. Programs were conducted by horticulture specialists in conjunction with the S.C. Nurserymen's Association, the S.C. Landscape and Turfgrass Association, the S.C. Greenhouse Growers Association, the S.C. Apple Growers Association, the S.C. Peach Council and Promotion Board, kiwi fruit growers and members of the golf course and sod producing industries.

The National Peach Council held its national meeting in South Carolina last year, and the Horticulture Department helped organize the program.

Ninety-four Master Gardeners attended the Advanced Master Gardener Training Conference at Clemson June 26-28, 1991. Four issues of the Master Gardener newsletter, "Greenspeak," were mailed to more than 1,200 Master Gardeners across the state.

Multi-state in-service training for fruit agents was held, with six states participating. This allowed for technical training that could only have been obtained through this multi-state approach. Agent in-service training sessions were conducted on home grounds problem identification, commercial vegetable production, commercial turfgrass production and small fruit production.

The department is placing major emphasis on computer applications. Using a departmental computer laboratory, an in-depth session on computer-assisted landscape design was held. A computer applications demonstration held at a meeting of South Carolina nurserymen drew many favorable comments.

In addition to newsletters and other Extension publications, a new type of material has been created and printed. The home grounds fact sheets and the home garden leaflets are designed to provide information about landscape features or production information.

Extension horticulture specialists are beginning to obtain visibility and experi-

ence in international horticulture. Their experiences will be valuable in working with producers entering the international market place. Specialists accompanied South Carolina growers on a trip to Chile and visited the fruit-producing area of Egypt. One individual made two trips to China and presented a paper at a meeting in Mexico. A vegetable and a tree fruit specialist was in China earlier this fall and plans to visit Brazil this summer.

Plant Pathology and Physiology Department

Low levels of tomato spotted wilt, a new disease for South Carolina tobacco growers, and a problem for tomato, ornamental and peanut producers, were detected in South Carolina. This year damages were minimal, but this disease could be very destructive in the future. For this reason new turf fungicides and biological control strategies and products were demonstrated to county Extension agents and growers this year.

Applicator exposure and non-target undesirable environmental effects of nematocides have been reduced through new application technology. The impact of nematodes on cotton and soybeans, currently affecting 50 percent of fields, is being reduced through proper management practices. Small grain losses to disease have been reduced significantly with the help of a new small grain disease assessment and management guide published by Clemson Extension.

The Plant Problem Clinic, an in-service training facility that capitalizes on the "teachable moment," and through its diagnostic services saves growers money, reduces unnecessary application of pesticides to the environment and helps the public understand the importance of pests. By processing samples from county Extension agents and Master Gardeners, the clinic has a significant impact — almost 3,300 samples processed during the past year.

By providing information that gives clients a greater understanding of disease, Extension plant pathology and physiology is helping growers get involved in the production of small fruits as alternative or second or third income source. Fruit growers also are using computer models to reduce bactericide impacts on the environment, reduce grower costs and improve disease control. Packing house losses are being reduced through better chlorine technology.

Poultry Science

The Clemson Extension poultry program has used in-house workshops, seminars and field demonstrations to educate more than 50 percent of the state's poultry industry personnel and contract poultry producers on the proper methods of environmental control. Working with industry personnel, a summer ventilation program, which has reduced animal stress and mortality from summer heat, was developed.

A seminar on proper waste use was developed to address poultry producers' concerns about poultry waste land application. More than 100 poultry producers learned about application ratios, impact on water quality and composting of mortalities.

About 200 youth actively participated in the poultry youth program, learning about proper food handling, poultry production and poultry science. A Fetal Alcohol Syndrome program, using the avian embryo as a model, was developed for use by elementary school teachers.

Strengthening the Family

Family Life Education

The Parenting Renewal program continues to be a widely used program. According to a sample of 54 parents who attended all nine sessions of the series, which is designed for parents of children from birth to four years of age, the program is having a positive impact.

Of those sampled:

- 93 percent intended to show more affection to their children as a result of the program.
- 94 percent reported that they were better able to cope with the stresses of parenting as a result of the program.
- 96 percent reported that they were trying harder to listen to their child/children as a result of the program.
- 83 percent reported they would try to use less harsh discipline as a result of the program.

This year more than 2,000 families were reached with parenting information through Parenting Renewal programs. These may have been conducted with parents attending classes or receiving the leaflets as a mail-out series. The above number does not include the number of times information was delivered through radio, newspaper articles and television interviews.

Since there is an increase in requests to teach Parenting Renewal to abusive parents, some who are referred by the S.C. Department of Social Services, an in-service training for 46 county Extension agents was conducted. The training, entitled "Working With Parents of At-Risk Children," teaches volunteers to conduct Parenting Renewal classes.

Extension's family life education efforts also provided information to clients through the Children and Adult Resource Express (CARE) database. This information and referral system, partially supported by the Health and Human Services Finance Commission, includes up-to-date information about services and service providers for dependent children and adults. It also contains information about legislation, educational opportunities, daycare for children and adults, and living arrangements for the elderly. The information is free to the public through county Extension offices.

Family Resource Management

Program efforts during 1990-1991 have been directed toward helping individuals and families develop financial management skills to help them use available resources to ensure lifetime financial security.

Priority programming areas have included financial recordkeeping, personal financial analysis and goal setting. Thirty-four counties reported reaching 8,000 adults in these areas. Of those reached, 34.2 percent organized a home filing system and 27.8 percent gained knowledge about the importance of lifetime financial planning. More than 900 individuals identified their life cycle situation and accompanying financial tasks they need to complete, and 65.4 percent established short- and long-term financial goals. In addition, more than 5,000 individuals requested and received information related to the selection of goods and services. Another 15,815 contacts were made in the resource management area by agents in the 34 counties.

Programming in financial management also was extended to youth, with more than 1,000 young people participating in various programs designed to teach the costs of living in the "real world." In addition more than 1,050 young people participated in a career exploration program developed and conducted by Extension staff.

The program "Go For The Goal" is an action-packed program using a video tape, two computer programs, numerous activity sheets and a printed publication to help young people select a career track that reflects their interests and abilities. The program also shows them what career choices can provide the lifestyle they desire. Several school districts in South Carolina also have used the program, which has been shared with 24 other states.

Additional programming efforts included a special topics course, "Educating Youthful Consumers." Twenty-five public school teachers learned how to incorporate consumer education topics into the diverse courses they teach. In evaluating the experience, one participant stated, "I would like to see this course mandatory for teacher certification for all teachers...."

Housing

During the 1990-91 fiscal year South Carolinians saved about \$273,404 by using Extension home moisture publications, according to reports from 23 counties in the state. In addition 69 new homes were designed or built utilizing techniques to prevent moisture problems, and 384 existing homes were altered to correct or prevent moisture damage.

Housing industry professionals in South Carolina are collaborating with Extension agents and specialists to build industry awareness of preventive and corrective techniques, with 1,231 industry officials having been trained by Extension in how to prevent moisture damage. This knowledge will help industry professionals provide improved service to their consumers and minimize future liability losses. Sixty-seven lay leaders, including Master Gardeners and Extension Homemakers Club members, also received Extension training on this topic.

Five videotapes produced by an interdisciplinary group of Clemson faculty are being used to train housing industry professionals and other public groups. This will increase homeowner and public awareness of the problem and reduce the potential for costly home damage. The 15-member Clemson University Housing Industry Advisory Council has used the videotapes to teach colleagues about the problem.

Research conducted by a Clemson Extension specialist also is being used to teach current and potential homeowners and industry professionals about home moisture damage. The instruction is being administered primarily through builder home shows and industry educational programs.

The research, which chronicles the frequency of home moisture damage in South Carolina homes and the probable causes of such damage, showed that 69 percent of responding homeowners from 16 counties of varied geographic areas of the state reported having moisture problems or moisture damage in their home.

More than 140 South Carolinians learned what to consider in buying or planning a new home at seminars in five counties. The presentations included information on how much house one can afford, design considerations for life cycle accessibility and independence, energy efficient features, choosing a realtor or home inspector, what an appraisal is and inspection pointers for evaluating an existing house.

As a result of efforts by Extension professionals the following accomplishments were made this year:

- 23 homes were built or altered for accessibility by elderly or handicapped occupants.
- 110 homes gained added, improved or reorganized storage.
- 90 new or remodeled homes were planned and/or built with Extension help.
- Clients saved \$168,730 as a result of Extension help with plans for new or remodeled homes.
- 33,543 square feet of home space were built or remodeled with Extension help.
- 72 families improved home safety, air or water quality, and energy conservation practices.
- 72 families considered and/or chose alternative housing to meet family needs.
- 30 families improved household pest control using Extension information, saving \$400 in costs.
- South Carolina citizens gained housing improvement information from 80 housing industry professionals who helped Extension agents teach housing programs.

With housing being a family's largest lifetime purchase, and housing taking the

largest proportion of a family's monthly budget, the importance of ongoing availability of Extension's research-based housing information is clear.

Developing Human Resources

Health and Wellness

Through collaboration on the state and local levels, programs and activities were conducted to reduce the teenage pregnancy rate in South Carolina. Extension conducted a statewide in-service training to update the Local Teenage Pregnancy Prevention Councils. It focused on the economic impact of teen pregnancy as it relates to the teen, family, school, community and health care system. A representative from the Southern Governor's Association discussed barriers to teenage pregnancy programs in the South.

February 1991 was declared "Teenage Pregnancy Prevention Month" by Gov. Carroll A. Campbell. Councils throughout the state intensified programs through school health fairs, speakers' bureaus, in-service training, peer mentoring, tutoring and mass media. On February 13, 1991, Extension agents from all 46 counties, along with other professionals and youth across the state, participated in the "Teen Pregnancy Prevention Legislative Awareness Day" at the Capitol. The theme for this collaborative effort was "Let's Go All The Way for Teen Pregnancy Prevention." About 125 adults and 300 teens attended the activities, and more than 500,000 people were reached via television.

Local councils are maximizing teen pregnancy prevention efforts through successful grant writing. More than 34,600 youth, parents and educators were reached this year with educational programs on self esteem, goal-setting, communication, decision-making, substance abuse, male/female reproductive health, peer pressure, stress management and family relationships.

More than 70 health professionals at 14 sites across the state participated in a maternal nutrition video conference telecast live from Clemson University. During the 22 hours of programming, co-sponsored by the March of Dimes, participants received the latest information on maternal weight gain, substance abuse, pre-conceptional health and counseling skills they will use to guide women to more healthy food choices during pregnancy. The goal of the program was to lower South Carolina's infant mortality rate — one of the highest in the nation.

"Baby Talk," an age-paced newsletter developed for parents of newborns, went to more than 2,750 families. Evaluation following the series indicates these parents now spend more time with their child. More than 50 groups are networking with Extension at the local level in an effort to improve the health of mothers and babies.

Human Nutrition, Food Quality and Food Safety

Clemson Extension continues to emphasize human nutrition programs for reducing the risks of developing chronic illnesses such as heart disease, stroke and cancer. Extension is considered the most reliable source in the state for presenting educational programs on the quality of the food supply, food safety and the conservation of foods.

The success of these educational programs can be measured in two areas: 1) Consumers are making wise food choices and 2) food is being handled more safely. County Extension agents reached more than one million consumers with information in these areas through the media and direct contacts. Reports show that more than 5,000 clients adopted healthier dietary practices; more than 250,000 learned the relationships between nutrition and chronic disease; and approximately 20,000 learned to evaluate food and nutrition information.

Because of the complexity of food issues and the lack of understanding of the interrelationships within the food system from production to consumption, food quality teams consisting of an agriculture agent and a home economics agent have been designated in each county. As food safety issues arise, Extension specialists

provide these teams with information to help consumers understand the issue and make better choices.

The safe handling of food at home is a program area that received major emphasis in state and county Extension programs. In program year 1991 more than 350,000 consumers learned about using sanitary food practices in the home. More than 170,00 consumers adopted safe food preservation techniques. Trained volunteers are working in 12 counties that have the Master Food Preserver programs. These volunteers have received in-depth training on the safe handling and preservation of food at home. The volunteers then passed that training on to other clients. For example these volunteers assist county Extension staffs in providing educational programs in their communities, training other volunteers and judging food entries at county fairs.

Human Nutrition (EFNEP)

The Expanded Food and Nutrition Education Program (EFNEP) is a federally funded program administered in South Carolina by the Clemson Extension Service. Its primary purpose is to improve the diets of limited-resource families, thus enabling them to enjoy better health, improved stamina and increased productivity. EFNEP includes programming for two primary audiences — young families with children and youth below the poverty line. About 19 percent of the state's population (303,998) lives in poverty.

Last year 4,205 limited-resource homemakers were reached through the EFNEP Adult Phase in 41 South Carolina counties. About 40 percent of them reached a designated level of proficiency in relation to food, nutrition knowledge and food practices in 12 months or less. About 90 percent of those enrolled showed improvement in their diet and food handling practices.

About 5,800 youth were involved in EFNEP last year. They learned how to make wise food choices, how to prepare nutritious snacks and simple meals, and how to handle food safely. The majority of them participated in community groups led by volunteer leaders. About half also participated in regular 4-H activities or stayed in 4-H after graduation from EFNEP.

About 800 volunteers contributed more than 8,800 hours to EFNEP. EFNEP homemakers were informed of services of other agencies, especially those related to health and nutrition. There has been a continual increase in the number of referrals to EFNEP from other agencies in the past few years.

Leadership

The leadership program has been centered around three objectives: (1) enhancing the networking of public and private agencies and individuals working to develop local leadership potential; (2) developing a leadership training system which enables citizens to develop personal and group leadership skills; and (3) developing mechanisms for professional staff to work effectively and efficiently with local people.

The primary effort in achieving the first objective has been the Palmetto Leadership Program funded through the Kellogg Foundation and the state of South Carolina and administered by Clemson Extension. Clemson University and South Carolina State College are providing in-kind services for the program. Sixteen counties across South Carolina have been involved in a series of leadership classes. These training sessions have provided local citizens with specialized training on personal leadership development and strategies through which they could become involved with local public policies and problems. Through these classes, empowered citizens have become involved with a number of local community needs and many have become driving forces for changes within their counties.

The second objective is being met through the Family and Community Leadership (FCL) specialized curriculum. This training includes two phases, with the result being at least 20 hours of volunteer service by each program participant. A number of significant accomplishments have been achieved by trained volunteers in

several counties. Overall, 248 people representing 44 South Carolina counties have had at least some part of the FCL training. Of this number, 119 completed the training and are certified FCL trainers. Through the efforts of these trainers, more than 18,500 volunteer hours have been contributed to community service, and 21,700 other individuals have received some leadership training in local communities.

The third objective is being addressed through study tours of a variety of outstanding programs. These tours have resulted in a number of creative new volunteer programs being initiated in several counties. A "Teen College," which helps teens work in more capable leadership roles, is an example of such a program. New volunteer management procedures using volunteer "middle managers" and a new computerized volunteer data management system are other examples. Special emphasis has been placed on the development of specialized program committees. This has resulted in the development of 10 county committees focusing on the specific needs of communities.

Youth Development

South Carolina's youth are the human resource for future growth and development of our state. The youth of today are at risk and, therefore, the future could be at risk. The 4-H youth development program is the educational component for youth of the Clemson Extension Service. During the 1990-91 program year major emphasis has been placed on developing significant coalitions with other youth-serving agencies, University departments, institutions of higher learning, commodity groups and state government agencies.

These coalitions are providing the basis for exploring the present youth situation and developing preventive educational programs to eliminate at-risk factors for youth or lessen the impact of these factors on our young people. Some programs have dealt with such areas as drug and alcohol abuse, leadership and decision-making, skill development and building self-esteem. Programs have been delivered in homes, at campgrounds, in community centers, at schools and in cooperation with churches.

The function of 4-H and Youth Development is to take the youth development education effort to the communities and environment where young people live. Programs are implemented through the joint efforts of Extension staff, local citizens, parents, volunteers and other community-based agencies. The volunteer effort consists of trained adults teaching youth, older teens acting as tutors and/or mentors for younger members, and individuals/organizations providing financial or human resources for curriculum development and implementation.

Developing skills for coping in life's situations and leadership qualities necessary to contribute effectively to the community are primary goals of the program. The curriculum also allows youth to gain various levels of technical competency in several areas of science, basic life skills and communication.

Last year nearly 60,000 youth and more than 4,000 volunteers were involved in this educational effort. It is a 100 percent voluntary effort for youth nine to 19 years of age. Of the youth participating, 51 percent were black and 49 percent white, with participants living in rural, urban and suburban areas of the state. 4-H youth development education continues to provide a system for transferring the knowledge of the land-grant system to precollege age youth in South Carolina.

Developing Communities

Rural and Community Resources

Clemson Extension agents serving 30 counties participated in a statewide in-service training program on Solid Waste Management on January 30-31, 1991. The training was conducted by Clemson Extension specialists and experts from relevant state agencies and the private sector.

During the two-day program agents received training on conducting recycling programs, composting, disposal of household wastes and pesticides, siting landfills

and provisions of the Solid Waste Policy and Management Act of 1991. Model programs in solid waste management already under way throughout the state were presented and analyzed for use in other locations. The intent of the training was to equip agents to conduct educational programs and provide assistance to communities in meeting the requirements of the recently passed (May 27, 1991) state Solid Waste Law.

The Palmetto Leadership program continues to be effective in providing leadership training at the county level. Six additional counties joined the program during the past year, bringing the total number of participating counties to 16. As of May 31, 1991, 728 community leaders have graduated from the program. The program continues to provide leadership and economic development training as well as technical assistance. Training is provided by University faculty and other resource specialists. Task forces are created in the participating counties to address identified problems. These task forces are able to utilize the expertise of resource teams composed of representatives of state agencies and non-profit development entities. The resource teams provide expertise on a broad variety of subjects relative to community development. Some examples of successful projects conducted by county task forces include the following:

- Formation of a county-wide Chamber of Commerce;
- A scholarship program to "Grow Our Own Teachers";
- Completion of a county tax-base study analysis;
- Development of a county-wide appearance improvement plan;
- Development of a plan to improve county-wide recreation;
- Development of a plan to promote and coordinate community support for festivals and celebrations;
- Preparation and dissemination of a report on a study of public school facilities;
- Initiation of a waste recycling program; and
- Development of a referral service from the county employment office to an adult literacy program.

Work initiated last year through Extension in cooperation with the S.C. Department of Parks Recreation and Tourism on developing bed and breakfast businesses in South Carolina received critical acclaim from several sources. A publication developed in conjunction with the project, "Beginning Bed and Breakfast in the South: Guidelines for Development," received the "Most Notable Publication Award" from the South Carolina State Library. The project also received the Southeastern Tourism Society's "Bright Idea" award and the National Association of Development Organization's "Outstanding Development Program" award. As a result of the program, the S.C. Bed and Breakfast Association has been established, and 20 new bed and breakfast businesses have been started during the past year.

A quarterly publication initiated by Extension to help communities in their economic development efforts is proving to be very successful. The publication presents summary discussions of timely issues relevant to small town economic development. Extension also has published "A User's Guide for Local Economic Impact Analysis." The guide permits local governments to estimate the total income and employment changes resulting from gaining or losing a major industry.

Extension also co-sponsors the Community and Economic Development Program with the Strom Thurmond Institute and the S.C. Agricultural Experiment Station. This program, initiated in 1990, is designed to harness the resources of all parts of the University in support of grassroots efforts to:

- Improve the efficiency of government services;
- Enhance knowledgeable participation in civic affairs;
- Expand economic opportunities;

- Achieve orderly adjustments to social change; and
- Provide for a safe, healthy and pleasant environment.

Information is provided by the program through "The Community Leader's Letter." This newsletter, written by faculty and associates of the Strom Thurmond Institute, is published quarterly and sent to more than 15,000 grassroots community leaders. It provides an in-depth analysis of a broad range of timely topics of interest to community leaders.

Clemson Extension continues to support the Governor's Community Improvement Board and the Parks, Recreation and Tourism Commission through the provision of organizational assistance to county community improvement councils and committees. About 2,000 elementary and high school students annually take part in a poster contest designed to promote litter awareness among youth. The contest is sponsored by the Governor's Office with assistance from Clemson Extension. Community improvement councils and committees across the state also are assisted by county Extension offices in meeting criteria for awards presented at the Governor's Annual Community Improvement Awards Banquet. Thirty-five counties participated in the awards program in 1991.

DIVISION OF REGULATORY AND PUBLIC SERVICE PROGRAMS

The Division of Regulatory and Public Service Programs was formed in 1970 and consists of the director's office and four departments: Fertilizer and Pesticide Control, Plant Industry, Seed Certification and a portion of Agricultural Chemical Services.

The division's mission is to ensure compliance by regulated industries and individuals with legislative mandates and regulations. The division also provides its target audiences assistance and services to educate and achieve compliance.

Division programs promote the use of certified seeds and plants; provide the services needed for certification of crops and plants; assure that fertilizers, lime, pesticides and seeds meet the standards to produce marketable, safe and profitable crops; provide inspections to monitor pesticide treatments by the pest control industry; and provide inspection to assist the state's plant industry in maintaining plant material and agricultural commodities apparently pest free.

The following activities, by department, highlight the division's work for 1990-91.

Agriculture Chemical Services

This department performs the chemical analyses reported by the Department of Fertilizer and Pesticide Control. Most samples were multi-component, with more than 20,000 individual analyses made.

The laboratory has concentrated on improved methodology, instrumentation and organization to analyze all samples quickly and accurately. The department performed more than 25,000 analyses for the S.C. Agricultural Experiment Station during the fiscal year. In addition the Agricultural Service Laboratory processed more than 64,000 soil samples, 5,200 plant and feed samples and 5,000 samples for nematodes.

Seed Certification

Seed Certification is a program of standards imposed on the seed and plant pro-

duction industries that ensures varietal purity, good germination and freedom from noxious weed seeds. Participation in the program is voluntary.

In 1945 the General Assembly designated Clemson as the agency to inaugurate and carry out a program of certification of pure seed and plants in South Carolina.

Department field work in 1990-91 involved inspections of 37,657 acres of crops for certified seed production. Inspections included 84 varieties of 13 crops for 170 farmer/growers and 25 seed-producing firms. Inspectors checked each field to determine that the crop was true to variety and free of noxious weeds and seed-borne diseases.

Acreages of major crops inspected were: soybeans, 25,331; small grains, 10,603; cotton, 297; peanuts, 1,020; turfgrasses, 250; and pine trees, 116. Other field work involved grow-out plantings of 554 samples representing 277 lots of S.C. certified soybean and small grains seed to verify proper sampling and labeling.

During 1990-91 the department issued 599,021 certified tags to growers whose seed met standards in the field and laboratory. Personnel inspected and approved 26 facilities during the year for custom conditioning of S.C. certified seed.

Department of Plant Industry

The Department of Plant Industry's mission is to prevent the introduction and spread of plant and honey bee pests into, within, and from South Carolina through plant pest exclusion/quarantines/eradication, plant export certification, honey bee pest exclusion, nursery/greenhouse/transplant certification, boll weevil eradication and elimination of abandoned orchards. Activities this year included:

Nursery Inspections: By provisions of the Crop Pest Act the department licensed 650 nurseries, greenhouses and vegetable transplant growers plus 971 nursery dealers to sell plant material. Specialists visited an additional 549 establishments to determine compliance with quarantines and plant pest regulations. Forty-six other nurseries failed seasonal inspections due to pests, weeds or other problems. The department's specialists issued three stop sale, seizure orders for plants considered a public nuisance.

Phytosanitary Certification: The department facilitated plant material export or movement by issuing 224 state and 36 federal phytosanitary certificates. The certificates covered orchids, rose plants, chrysanthemum cuttings, seed, propagated native plants, anthuriums and hardwood lumber. Plants were shipped to other states and 27 foreign countries.

Special Inspections: The department issued 18 certificates of plant inspection for home owners moving house plants to other states. This service is provided when the destination state requires house plant inspection. Florida-bound home owners accounted for 55 percent of these requests. Pee Dee tobacco transplant growers requested special inspections allowing sale of 7,619,550 transplants to North Carolina growers.

Phony Peach Disease: Four temporary inspectors and three specialists from the department surveyed peach orchards in the S.C. Ridge and Coastal Plains for phony peach disease. Disease incidence in 1990 was 202 trees out of 1,316,600 inspected, or .02 percent.

Sweet Potato Inspection: Staff members made 29 pest detection inspections for eight growers in the Pee Dee, Sandhill and Coastal Plains regions.

Introduction of Honey Bees Into State Act: Departmental honey bee inspections

totalled 69, representing 1,384 colonies of bees. Sample analysis confirmed Nosema disease in two colonies, American foulbrood in eight colonies and European foulbrood in one colony. In general, honey bee colony symptoms indicate tracheal mites are playing a major role in colony losses in South Carolina. DPI surveyed 101 apiaries totaling 1,877 colonies for Varroa mite. Twenty-two of the apiaries in nine S.C. counties were found infested with low levels of Varroa mite. This marks the first record of Varroa mite in resident S.C. honey bees. Africanized Honey Bees were not detected in South Carolina this year, however DPI prepared AHB information and articles for the Extension Service and the media.

Neglected or Abandoned Orchards Act: Abandoned orchards cause a build-up of orchard pests that affect other fruit growers in the area. Under the Act, DPI performed investigations of abandoned orchard complaints. DPI achieved removal of 186 acres of nuisance peach trees by six property owners.

Cooperative State/Federal Programs: The department and USDA renewed a cooperative agreement in 1990 providing for seasonal employees. The agreement created temporary survey and control activity jobs in the witchweed and gypsy moth programs for about 75 people.

Witchweed: Only 10,452 infested acres in four counties remain in the state. This year 151 new infested acres were found and 2,627 acres were released from quarantine. Contractors treated 8,625 acres. Florence County was released from quarantine in 1990. Since the beginning of the program 70,347 (87 percent) acres have been released from quarantine.

Gypsy Moth: Trappers caught 174 adult male moths in 1990. Horry County accounted for 75 of that total, followed by Charleston and Beaufort with 36 and 26 moths respectively. Egg mass surveys conducted in Beaufort, Charleston, Greenville and Horry counties during the winter were negative. However, 300 to 400 larvae were caught in a Horry County campground during larval trapping surveys this spring, indicating a new infestation.

Boll Weevil: Cotton acreage in the state was 155,134 in 1990. A total of 942 growers paid fees of \$1,535,776. Again, the General Assembly appropriated \$200,000 to be refunded to cotton growers to offset a portion of their fees. The refund amounted to \$1.28 for each acre of cotton grown. Boll weevils were scarce in the eradication area, with only 11 reported for the year. In the buffer zone, boll weevil numbers were higher, but there was no economic damage reported. Growers were pleased with the eradication program and look forward to total weevil eradication in the state.

Imported Fire Ant: The imported fire ant continues to spread intrastate, and the 1990 IFA Quarantine revisions reflect recent infestations. The department assisted nurseries, turf growers and other establishments to meet plant shipment quarantine requirements. The Department of Plant Industry initiated compliance agreements with nursery establishments and supervised specific regulatory treatments for this purpose.

Department of Fertilizer and Pesticide Control

The Department of Fertilizer and Pesticide Control is responsible for education and enforcement of the provisions of a number of laws and regulations. The S.C. Fertilizer Law and the Liming Materials Act primarily are designed to ensure that consumers receive high quality fertilizer and lime. The Pesticide Act regulates pesticide storage, sale and use plus such areas as quality and structural pest control.

Some of the major activities of this department relative to fertilizer and lime from July 1, 1990 to June 30, 1991 follow:

| | |
|---|------------|
| Fertilizer tons sold..... | 508,328 |
| Fertilizer samples procured & analyzed..... | 3,538 |
| Fertilizer samples not meeting guarantee..... | 483 |
| Lime material & samples procured & analyzed..... | 206 |
| Total of liming material samples not meeting guarantee..... | 24 |
| Percent of liming material samples deficient..... | 11.7 |
| Fertilizer penalties collected, payable to state treasurer**..... | 19,865.86 |
| (Deficiencies where consumers not identifiable) | |
| Lime penalties collected, payable to state treasurer** | 785.19 |
| (Deficiencies where consumers not identifiable) | |
| Fertilizer registration fees collected, payable to state treasurer** .. | 37,590.00 |
| Lime registration fees collected, payable to state treasurer** | 822.00 |
| Lime permit fees collected, payable to state treasurer** | 1,630.00 |
| Fertilizer taxes sent to state treasurer** | 136,837.55 |
| Soil amendment fees..... | 200.00 |

**Actually recorded by state treasurer July 1, 1990-June 30, 1991, but may not correspond to final fees paid for the fiscal year.

The fertilizer tonnage sold this year was down 9.1 percent from 1989-90. Overall 13.7 percent of fertilizer samples did not meet the guarantees within the investigational allowances. This deficiency rate fell from 1989-90. Other than deficiencies the greatest problem in the fertilizer and lime areas continues to be the lack of proper labeling of bulk material.

The S.C. Pesticide Control Act mandates quality control monitoring and regulates the sale, use and application of all pesticides used in South Carolina. This department uses a strong preventive education program coupled with fair enforcement actions to help ensure productivity while preventing adverse effects on man or the environment.

To improve its education and enforcement capabilities the department has pursued external funding without decreasing the flexibility of the pesticide program. These efforts have resulted in a \$570,500 grant from EPA. The department also has made a concerted effort to increase efficiency by using state-of-the-art data management. All fees collected under this act are sent to the state treasurer.

In 1990, 789 companies registered 7,920 pesticide products for sale in South Carolina. The department collected and analyzed 732 pesticide samples. Inspectors found five deficient in the guaranteed percentage of one or more ingredients and issued stop-sale notices. The department collected \$139,729 in registration fees.

Using provisions of the Federal Pesticide Control Act, the department issued 11 Section 24 (C) special local need registrations. The EPA granted two Section 18 emergency exemptions solicited by the department.

Pesticide dealers and applicators must be certified and licensed to buy, sell or apply pesticides classified for restricted use. Last year the department issued 10,321 private applicators licenses, 2,288 commercial applicators licenses, 912 noncommercial licenses and 357 pesticide dealers licenses. Certification fees collected totaled \$57,549.

In the area of education and enforcement the department's specialists made frequent contact with pesticide users, including dealers, growers, applicators and consumers. The structural pest control area requires particular attention. The Pesticide Act was amended to strengthen regulatory efforts. Meetings with pest control operators were necessary to assist this transition. The department has implemented regulations for licensing the structural pest control industry and those mandated by the Chemigation Act.

Enforcement actions against violators were decisive but fair. As part of the

EPA/Department of Fertilizer and Pesticide Control Cooperative Enforcement Grant, the department made 40 marketplace inspections, 200 certified applicator record checks and 300 restricted use pesticide dealer inspections.

The department levied 61 civil penalties ranging from \$100 to \$1,000 and totaling \$20,250. Three criminal prosecutions resulted in convictions. Investigators pursued 585 cases of potential pesticide misuse, complaint or noncompliance with regulations. They issued numerous stop-sale notices for unregistered products, sale of restricted products by unlicensed dealers and other alleged violations. The department issued warning letters in 224 cases. Overall compliance with the act by members of the agribusiness industry has been excellent.

LIVESTOCK AND POULTRY HEALTH DIVISION

The Livestock-Poultry Health Division conducts a number of regulatory programs in consumer protection, animal health and the diagnosis of various diseases in S.C. livestock.

The division's three main responsibilities are the administration of the S.C. Meat and Poultry Inspection Programs, the Livestock Health Programs and the Animal Diagnostic Laboratory.

Meat and Poultry Inspection

The S.C. Meat and Poultry Inspection Department serves as a public health regulatory agency functioning within the guidelines of state and federal laws to ensure that meat and poultry products inspected by the department are safe, wholesome and accurately labeled.

A memorandum of understanding to standardize on-farm investigations of drug residue violations, reporting procedures and regulatory actions was initiated and finalized among the U.S. Department of Agriculture, U.S. Food and Drug Administration, S.C. Department of Agriculture and Clemson. The four area veterinarians have been trained and accredited to conduct sulfa-on-site testing for sulfamethazine adulteration of hog carcasses. On-farm investigations have been successful in reducing the number of repeat violators.

The USDA conducted a review of the S.C. Meat-Poultry Inspection Program and found the state program "at least equal to" the federal inspection program.

Approximately 110 meat and poultry plants are inspected periodically — depending on volume of operation — for plant sanitation and product quality. An active compliance program is in place to ensure that the department will continue to provide effective and efficient inspection services.

Animal Diagnostic Laboratory

The laboratory uses post-mortem examinations, parasitology, bacteriology, virology, hematology, histopathology, blood chemistry, serology and many other testing procedures to diagnose disease, monitor vaccine reactions or disease exposure and monitor herd/flock health. Information is provided through veterinary practitioners or directly to owners. This service, which covers animal agriculture plus companion animals, includes agent identification, antibiotic sensitivities and management advice when applicable.

The laboratory also supports public health through investigation of mosquito-borne equine encephalitis, which may be fatal to horses and humans. The presence of this disease is reported to the S.C. Department of Health and Environmental Control (DHEC). Other diseases communicable from animal to man such as *Chlamydia psittaci* also are reported to DHEC. In cooperation with the National

Poultry Improvement Plan, the laboratory is monitoring egg-type chicken breeder operations for *Salmonella enteritidis*.

The annual volume of certain tests is high. Equine Infectious Anemia (EIA) tests totaled 26,388 in 1990 with 34 positive tests — a three-fold test increase over 1989 but with six fewer reactors detected. Pseudorabies tests on swine increased to 14,306 during the year. Brucellosis tests totaled 174,386. Poultry ELISA tests monitoring vaccine reaction or disease exposure numbered 21,368 for the year.

Livestock Health Programs

The Livestock and Poultry Health programs function in both regulatory and public service areas. In public service the division provides general diagnostic assistance to farmers and veterinarians at a level that is unique in the nation. In the regulatory area the division conducts a surveillance program for major infectious and contagious diseases of livestock and poultry, plus diseases of economic importance. The division investigates and diagnoses all reports of these diseases, taking appropriate action to control and prevent their spread, such as quarantine.

Despite having one of the smallest field groups in the nation the division's records in this area are among the best, conducting more major disease investigations than any other state in the past five years. In the 1970s, the division eliminated Hog Cholera, an established plague-type disease with major economic impact. The USDA granted South Carolina free status for Brucellosis and Tuberculosis many years ago. Control programs have reduced Pseudorabies, the contemporary swine plague disease, to the point that South Carolina has no infected farms.

The division is in an advanced stage of a long-range control program. These efforts have generated great savings to the state's livestock and poultry industries as well as consumers. In the active implementation phases of a law to control Equine Infectious Anemia, an AIDS-type disease in horses, the division's workload has increased significantly.

Work also is ongoing in cooperation with DHEC on a number of diseases in animals that are of public health significance, such as Eastern Equine Encephalitis and rabies.

The Livestock and Poultry Health veterinarians perform unique functions in state government.

COLLEGE OF FOREST AND RECREATION RESOURCES

Founded in 1970, the College of Forest and Recreation Resources is responsible for promoting the wise management, use and stewardship of the natural resources of the state, region and nation. Under this mandate, the College of Forest and Recreation Resources continues to meet the needs of South Carolina through aggressive education, research and extension programs aimed at managing the state's assets and enhancing the quality of life for S.C. citizens through the wise use of leisure and the creation of pleasing living environments. The importance of this college's function comes under sharp focus when it is noted that the college is the center of expertise for two major industrial groups in South Carolina. Together, the forest, recreation and tourism industries contribute in excess of \$8.5 billion annually to the state's economy.

It also should be noted that on March 8, 1988, the Department of Aquaculture, Fisheries and Wildlife became a third department in the college. It is jointly administered by the deans in the Division of Agriculture and Natural Resources at Clemson University. The annual report for the Department of Aquaculture, Fisheries and

Wildlife will be listed under the teaching, research and Cooperative Extension Service sections of Agricultural Sciences.

Research and extension activities in forest management, wood utilization, recreation, tourism and service programs to special populations are carried by the Department of Forest Resources and the Department of Parks, Recreation and Tourism Management. Both programs offer educational programs from the baccalaureate through the doctorate degree. College programs also have utilized Clemson's expanded statewide interactive video network for expanding educational opportunities. In addition to traditional departmental structures, the college operates two research institutes under its auspices. The Regional Resources Development Institute (RRDI), created in 1981, focuses on issues dealing with natural resource allocation, nature-based tourism and community development throughout the state and region. The Archbold Tropical Research Center (ATRC), is the locus of a consortium of universities and agencies examining issues and problems associated with tropical ecosystems. ATRC also manages the Clemson Research Facility, Springfield Plantation, located on the island of Dominica.

The college has begun an effort to develop centralized interdisciplinary research facilities. The first program in this effort has been the creation of a state-of-the-art Geographic Information System (GIS) based upon a Sun 4330 platform with additional workstations and support peripherals. The facility has been instrumental in opening new research opportunities and has stimulated new graduate student educational opportunities.

Department of Forest Resources

The Department of Forest Resources' programs in education, research and extension are unique within the state of South Carolina. The department plays an important role in educating many of the foresters who manage the 12.5 million acres of forest land in the state. This resource is responsible for more than four billion dollars in annual sales of forest products produced by more than 1,000 wood-using industries.

As an integral part of the University's land-grant mission, the department's goal is to provide to the citizens of South Carolina, the nation and the world:

- Undergraduate and graduate educational programs that (1) produce forest management and forest product specialists of the highest professional competence and integrity, and (2) expose non-majors to the understanding, wise use and management of the forest and its products.
- Forestry and forest products research programs that furnish the scientific expertise and leadership required for technical advancement and wise management and utilization of the forest resources.
- Direction and technical guidance by presenting existing knowledge and new research results in a usable form to forest landowners, the public, resource professionals, wood products firms and conservation-oriented organizations.

During the past academic year 18 students received the Bachelor of Science degree, 16 in forest management and two in forest products. Eight received the Master's degree and one received the Ph.D.

A fourth study area in the department's new undergraduate forest resource management curriculum, public relations, was approved by the faculty and the University. The new curriculum became effective in August 1990. Not only do we hope to attract a broader range of students, we also hope to offer other courses which will take better advantage of the range of existing and future faculty expertise. The forest products faculty have likewise begun making changes in their undergraduate curriculum with recommendations to the entire faculty by the end of 1991.

Over the past year, a faculty committee began developing background material

for the Society of American Foresters Accreditation review which will take place in spring 1992. Using the society's guidelines, a report will be written which will review all phases of the department's educational programs with special consideration to their impact and interaction with the undergraduate program in forest resource management. This report will be reviewed by faculty, staff and students before submission to the on-site review committee.

Changes in faculty personnel over the past year have been highlighted by the retirement of Dr. Allen and the completion of the search and hiring of a new department head. Dr. Allen, who came to Clemson in 1966 as the Belle W. Baruch Professor of Forestry, ends a long and distinguished career in research, teaching and administration. From 1970 until 1982 he was the department head and oversaw the major building of the department in terms of both facilities and new faculty. During that time and through this year he taught Forestry 101 to all incoming freshmen and transfers. This entry-level course is remembered by many of our graduates, especially its concentration on ethics within the profession.

Dr. Michael A. Taras, department head from 1982 until the end of this past fiscal year, is returning to teaching and research. His replacement, Dr. William A. Leuschner, was chosen from an excellent field of candidates and began his duties on July 1, 1991. Dr. Leuschner, a forest economist, comes from Virginia Tech where he has been on the faculty for the last 20 years.

Also new to the faculty is Dr. Perry Peralta, a forest products specialist, who will do research in the area of wood drying and preservation. Dr. Peralta recently completed his Ph.D. at Oregon State University.

Faculty efforts in research during the year were underscored by numerous publications, many of which were from studies supported by state research and federal McIntire-Stennis funds. Some of the areas of intensive research presently ongoing are in geographic information systems, wood chemistry, biotechnology, nutrient cycling, silvicultural influences on watersheds, and habitat studies on deer turkey and fox squirrel. Outside grants totaled over \$1.1 million this past year which is an all-time high and is a credit to the department's growing reputation for quality research due to its excellent faculty and research facilities.

Our programs in research and public service have met some challenges. The faculty involved with the Forest Air Quality Research Laboratory on the Clemson Experimental Forest completed their work on the effects of acid rain and ozone on shortleaf pine. This effort, sponsored by the EPA and the Forest Service, will provide well-documented results concerning the effects of these major air pollutants on tree growth.

Other sponsored research involves studies on the movement of groundwater in coastal plain forests, economics of management alternatives for storm-damaged timber, and the assessment of hurricane damage on timber-related manufacturing industries in South Carolina. Also, the implementation of the New Perspectives Management Plan for National Forests has led to various projects for Dr. Steve Jones who has developed a landscape ecosystem classification methodology for use in Southern forests.

Clemson has developed a reputation for sponsoring first class short courses for updating professionals who have been out of school for a number of years. For the eleventh consecutive year, the forestry faculty taught a two-week continuing education course in Advanced Silviculture to U.S. Forest Service personnel from throughout the Eastern United States. And for the second year, we offered a three-week short course on "Managing Stand Structure and Composition" to Forest Service Wildlife professionals from throughout the nation. Both courses were coordinated by our extension specialists who likewise enjoy a reputation for quality presentations and information delivery. Six other forest courses of interest to the state's forest landowners also were offered in topics ranging from wetlands delineation to forest finance.

Extension personnel also continued to provide information to homeowners and landowners on how to best salvage their shade trees and timber damaged by Hurri-

cane Hugo. Also, some department faculty remained involved in statewide committees to providing guidance to the state's forestry sector which witnessed the felling of three times the state's average annual harvest in a six-hour period.

A large grant from the Forest Service through the S.C. Forestry Commission will provide continued momentum to the effort on how landowners can best recover from the disaster through proven forest regeneration techniques and proper salvage methods. Furthermore, there will be information developed which will be valuable if and when such a disaster were ever to strike our shores again.

While previous years saw the building of new labs, revising curricula and writing long range plans for the forest, the faculty has been more active this year in the actual execution of its activities. All this effort along with the changes in our administration has contributed to a sense of accomplishment as we undertake the serious business of educating tomorrow's forest resource managers and provide information to the state's citizenry on how to best manage its valuable forest resources.

Department of Parks, Recreation and Tourism Management

Teaching personnel in the Department of Parks, Recreation and Tourism Management (PRTM) are dedicated to excellence in education at the bachelor's, master's and doctoral levels. Professional preparation by our students leads to careers in public and private leisure-service agencies including: county and municipal leisure services administration; youth serving agencies; federal, state and county recreation and park resource management; therapeutic recreation program delivery systems; and the broad field of travel and tourism management. Furthermore, preparation at the doctoral level is directed toward research and instruction in academic settings.

Fall 1990 enrollment figures for the department are shown below:

| Undergraduate | 336 students |
|----------------------------------|--------------|
| Travel and Tourism..... | 36% |
| Therapeutic Recreation..... | 15% |
| Resource Management..... | 11% |
| Community Leisure Services | 9% |
| Undecided/Transfers..... | 29% |
| Graduate | 49 students |
| MPRTM | 29% |
| MS..... | 22% |
| Ph.D..... | 49% |

Highlights within PRTM's instructional program for the 1990-91 fiscal year included:

- PRTM held its first student assembly in September. The assembly provided an opportunity for Larry Allen, head, to introduce the departmental faculty to all PRTM majors, describe PRTM's mission, introduce practicing professionals and expose newer students to the student clubs in PRTM.
- PRTM participated in Telecampus, a unique graduate-level educational outreach program available to practicing professionals throughout South Carolina.
- PRTM completed much of the data collection and analysis related to a revision of its undergraduate curriculum. Remaining is official endorsement by the University's Undergraduate Curriculum Committee prior to its implementation which is anticipated in the fall of 1992.
- PRTM's graduate curricula also underwent some refinements with greater specification regarding minimum course requirements within PRTM and in

the area of research methods and statistics. As reflected in the enrollment numbers above, approximately half of PRTM's graduate students are in its Ph.D. program. The Ph.D. program continues to expand at rates much greater than originally expected.

- A PRTM graduate student, Ann Wing-Vogelbacher, received the J. Desmond Slattery Marketing Award from the Travel and Tourism Research Association. This is one of the most prestigious awards in the nation for graduate students in the Travel and Tourism discipline.
- PRTM hired a full-time faculty member to coordinate the Leisure Skills program at the University. Bonnie Stevens will provide leadership to the Leisure Skills program which has as its primary objective lifestyle development and enhancement through the participation in and enjoyment of leisure activities.
- PRTM successfully held its second annual Intern/Career Expo in February. Approximately 170 students interviewed for internship, part-time or full-time positions with 28 organizations representing government agencies and companies from the leisure and tourism industry.

Research

Faculty had a very successful year, receiving seventeen grants and contracts amounting to \$313,338 in new and continuing research activities. They continue to pursue research which will bring national visibility to Clemson and South Carolina. In addition, data from numerous regional, national and international recreation surveys have been obtained which will allow Clemson to analyze many important leisure-related problems and opportunities. This could lead to recognition of PRTM as a national recreation data repository and analysis center and promises to enhance the research thrust within the department.

Faculty made 20 research presentations at national and regional meetings and 37 other professional presentations to a variety of audiences. Graduate student presentations were encouraged and presentations by these students representing Clemson were also productive. Faculty and graduate students generated 57 publications, with over two-fifths (25) appearing in national refereed journals. Faculty are continuously requested to serve as referees of research publications and serve on editorial boards of several professional journals.

Public Service/Extension

The department's commitment to education extends beyond involvement with undergraduate and graduate students to include ongoing and other successful programs aimed at various audiences. Several public service activities during fiscal year 1990-91 included:

- College Week for Senior Citizens, two one-week programs, served more than 350 citizens from South Carolina and the surrounding region and generated in excess of \$54,000 in gross income.
- A symposium regarding present and future management issues related to the Chattooga River was held. Numerous issues were discussed regarding the nearby river which is one of the nations best known wild and scenic rivers.
- A Community Tourism Development Workshop was conducted for the benefit of local S.C. government officials.
- Numerous professional presentations were delivered to association and related meetings at state, regional and national levels.
- Faculty served on professional boards, editorial boards of national journals, and held offices in professional associations. One faculty member currently serves as the president of Rho Phi Lambda National Honorary Society, the honor society associated with PRTM-related curricula.
- The new S.C. Rural Recreation Development Project got under way, under

the direction of Grant Cunningham, with recreation programs and services being provided during the summer months at four S.C. communities: Central, McCormick, Pageland and Ridgeland. As part of the overall project, new communities will be added each year and will receive recreation programs and services via a local director as well.

- Tom Potts was notified by the S.C. State Library, that his publication, *Beginning a Bed and Breakfast in South Carolina: Guidelines for Development* was selected as one of the ten most notable documents published by state government in 1990. The publication was issued by the Clemson University Extension Service and the S.C. Department of Parks, Recreation and Tourism.

Outdoor Laboratory

In 1990-91 a nearly identical number of people was served at the Clemson University Outdoor Laboratory as compared with the previous year (12,910 to 12,930). However, 23 more groups used facilities at the Outdoor Laboratory than during the previous year (245 to 222).

The most glaring reduction in days of use during the year was due to the cancellation of a major program usually hosted by the Forest Resources Department. In 1990-91 this single cancellation resulted in an unanticipated loss of 35 user days. Thus, when compared with the previous year, excluding the summer season, the Outdoor Laboratory had groups on the property for 240 days in comparison to 266 days during 1989-90. Without this single loss, current annual statistics would have equaled or surpassed those of previous years.

The summer camps were again near capacity. More than 700 special citizens were served through the six residential camps. The loss of Camp Paupi Win, a one-week residential camp for adjudicated youth, was compensated by the expansion of Camp Sertoma to a seventh week. More than 50 students from colleges and universities across the country worked in the program department. Fifteen of these summer staff were from Clemson and represented 12 disciplines. Seven of the summer staff were male students recruited with help from the Pi Kappa Phi fraternity national office (see PUSH later in this project).

The South Carolina Jaycees raised nearly \$50,000 to support Jaycee Camp Hope. Of that, \$35,000 was given to subsidize the camper fees, \$5,000 was given to Rainbow For Hope, and \$2,400 was given to Project Push. The balance will be contributed this year for special projects.

The Sertoma Board of Directors sponsored the first seven-week camp in the history of Camp Sertoma (22 years). This enabled 260 children to attend. As usual, Sertomans from across the state fully funded each child. Sertomans continued to establish groundwork for an endowment for future funding. Additionally, the North Lake Sertoma Club of Columbia donated \$2,500 which assisted in the development of a games field at the Outdoor Laboratory.

The Mid-Day Lions Club of Anderson sponsored Camp Lions Den for the 12th consecutive year. Thirty-eight campers with visual impairments attended. Camp Running Brave for hemophiliacs attracted a record enrollment, 72 campers, for one week. With the concern for AIDS, the registration for this camp had declined during the previous two years. High enrollment for 1991 was very encouraging. The Muscular Dystrophy Association sponsored another successful camp. Because of an anticipated small enrollment, this program operated concurrently with the last week of Camp Sertoma.

During the fall three sessions of Senior Adventure Camp attracted 100 participants to the Outdoor Laboratory. This program currently is being carefully reviewed with the goal of increased enrollment and renewed marketing in the near future.

During the spring an additional school joined our list of environmental education participants. Riverside Elementary School joined Morrison, Central and East End of Easley in environmental education programs developed and led by the Outdoor Laboratory professional staff with support from PRTM students.

A significant income was attained in the use of the Outdoor Adventure Course. During the past year 120 different sessions were conducted. We also sponsored a facilitator training course in November and five Clemson students were approved for this high adventure activity.

The Outdoor Laboratory sponsored Campfest in March. Forty-eight camp directors attended, and about 500 Clemson students stopped by for summer job contacts and interviews. This has become a significant event for southeastern camp directors who rate Campfest as the best placement day they attended.

In March the Outdoor Laboratory hosted two different sessions of PUSH Camp (People Understanding the Severely Handicapped). This was a national project of the Pi Kappa Phi fraternity. Each year, member brothers from schools across the country apply to work at PUSH camps during their schools' spring break. There were four PUSH camps in the United States last year and the Clemson Outdoor Laboratory hosted two of those. More than 40 students worked hard to renovate and build facilities to benefit handicapped citizens. Additionally, the PUSH office provided the Outdoor Laboratory with nearly \$12,000 to support these projects. A tremendous spin-off from PUSH camp was the decision by seven students to return and work in the summer camps. Another PUSH camp is scheduled for 1992.

A new professional staff member was recruited during the past year. Dee Anne McDade joined the staff as recreation coordinator in early June following a national search. Ms. McDade has proven to be an extremely valuable addition to our staff.

While the programs and program funding remain strong, the major need for new money to rebuild and repair older buildings was conveyed to the administration at the college level during the past year. With many of the 24 separate cabins plus the major central facility and a heavily used conference building approaching 15 or more years of use, extensive work is needed. Roads and trails also need repaving. This past year was important in establishing the need and level of funding necessary.

As in previous years, the Outdoor Laboratory staff has given everything it could to insure success. They continue to work hard and willingly give their time beyond normal expectations of University employees. Our service has been no better than the quality of the Outdoor Laboratory staff and, based on user comments as well as statistical records, 1990-91 was an outstanding year.

Professional Development Program

PRTM develops and delivers programs and short courses for various outside groups including the USDA Forest Service Recreation Management Division. In particular, the twelfth Outdoor Recreation Management Short Course was held in September. This program offers mid-level federal planners and managers an opportunity to study outdoor recreation and its multiple-use implications. Although primarily available to USDA Forest Service employees, Bureau of Land Management, Tennessee Valley Authority and National Park Service employees have attended the short course as well.

New to this year's offering of programs was a Recreation Technician Short Course oriented toward federal, technician-level employees seeking a greater understanding of outdoor recreation management concepts and skills. This short course represents the first such training session of its kind in the United States. Both of these programs, under the direction of Gina McLellan, were staffed by existing faculty, support staff, graduate assistants and outside speakers when particular areas of expertise were necessary.

Regional Resources Development Institute

RRDI's work generally is organized under three major program umbrellas. Recent accomplishments are summarized as follows:

The John de la Howe School

- Continuing work with JDLH staff and Drakeford architects to bring country market plans on-line for a 1991 groundbreaking;
- Continuing plans with JDLH to develop community and regional help and interest with the operation of the market;
- Providing liaison assistance with the JDLH aquaculture program;
- Providing assistance for interdisciplinary graduate research at JDLH which benefits both institutions;
- Finishing work with College of Architecture on JDLH master plan and counseling center renovation;
- Facilitating a business concept plan for JDLH with the assistance of a Department of Planning Studies graduate student;
- Assisted initiation of evaluation research at the Wilderness Program of the John de la Howe School;
- Presented completed country market focus group reports to the staff of the John de la Howe School;
- Initiated efforts to design a marketing study for the JDLH country market facility.

The S.C. — Today and Tomorrow Program

- Continuing community development and compiling questionnaires for small towns in conjunction with the S.C. Downtown Development Association;
- Securing funding for community surveys to be used across South Carolina;
- Completed report on the S.C. Craft Survey and sent to the S.C. Arts Commission;
- Compiling the S.C. Crafts catalog;
- Continuing work with FRR faculty and graduate students to develop a "youth at risk" research program;
- Designing and implementing a study to analyze housing needs for retirees immigrating to South Carolina;
- Continuing work on the nature-based tourism video in South Carolina's coastal areas;
- Nearing completion of the book, *Nature-Based Tourism: An Annotated Bibliography*;
- Commencing a study on vernacular landscapes of the coastal region;
- Initiated an information exchange with the National Agricultural Library.

The Geographic Information System (GIS)/Natural Resource Program

- GIS Facility has been networked to a PC in the RRDI office;
- CD ROM drives have been installed in GIS Facility;
- Finishing efforts on the Southeast Regional Climate Center project which includes compiling a data atlas and a land use/land cover map for the Southeast;
- Attended project briefing with Applied Analysis Inc. and NASA at Bay St. Louis, Mississippi. RRDI will undertake cooperative research to transfer remote sensing and global positioning systems (GPS) techniques for wetlands delineation to Applied Analysis Incorporated (AAI);
- Continuing work with Ducks Unlimited to identify suitable areas for GAP analysis research;
- Commenced GPS/GIS project on sand migration in Charleston harbor with the College of Charleston;
- Field trip to Belize and Guatemala and meetings in Costa Rica with CARE

- International and the Regional Wildlife Management Program for Meso-america and the Caribbean;
- Meeting with USFS and AAI to discuss USFS project at the Savannah River Site.

Research Productivity

Current Grants:

National Coastal Research Institute
S.C. Arts Commission
Southeast Regional Climate Center
Provost Research Award

Grants Pursued or in Negotiation:

National Aeronautics and Space Administration
National Science Foundation
Hitachi Foundation
Institute on Aging
Agency for International Development
United States Forest Service

Computer Laboratories

Courses offered within the College of Forest and Recreation Resources continue to be adapted to provide students with computer application skills pertaining to the management of today's varied and extensive leisure and forest-related industries. Numerous courses within the college currently offer instruction in computer applications at the undergraduate and graduate level and additional courses will incorporate computer applications over the next few years. Student instruction related to computer applications is typically carried out in the college's IBM-PC Laboratory whereas the Data General Computer Training Center is usually reserved for USDA Forest Service training efforts and graduate student use.

The seventh year of operation for the college's IBM-PC Laboratory was once again successful. The laboratory is primarily used for undergraduate and graduate instruction. Twenty-two classes, 14 from PRTM and eight from Forest Resources, utilized the PC Lab for instructional purposes this year. In addition, more than 400 students utilized the PC Lab's facilities outside of class meetings with 278 from PRTM and 127 from Forest Resources. The combined use of the PC Lab for classes and individual student use tallied to just under 8,000 hours of instructional and student time spent in the PC Lab. The PC Lab also was utilized by outside groups including the USDA Forest Service, Continuing Engineering Education and participants in the College Week for Senior Citizens program.

The types of software now available in the PC Lab include word processing, spreadsheets, databases, statistics, graphics, grammar checking, forestry programs and telecommunications. To enhance the ability of students to do statistical analyses in the PC Lab, the computers also are outfitted with math coprocessors. Upgrading and diversification of some of the computers and related equipment in the PC Lab will be necessary over time to provide an up-to-date learning environment for students and outside users.

The Data General (DG) Computer Training Center was established as a cooperative effort between the college and the USDA Forest Service and is the only one of its kind in the nation. The center, now in its third year of operation, hosted 15 training workshops for more than 300 Forest Service employees and for college faculty and students as well. The Center also supports existing cooperative research and training programs.

Overall, the College of Forest and Recreation Resources is committed to a leadership role in both the leisure services and forestry fields. The utilization and con-

tinual improvement of the IBM-PC Laboratory and the DG Computer Training Center are important means to maintaining this leadership role.

Archbold Tropical Research Center

Clemson University received the donation of the Springfield Plantation from honorary Dr. John Archbold in May of 1989. In response to this donation, the Archbold Tropical Research Center was created. The center functions as a teaching, research and public service consortium of leading institutions. The charter members are: Clemson University, the Smithsonian Institution, the Medical University of South Carolina, the National Park Service, the State of New York-College of Environmental Science and Forestry, Syracuse University, Texas A&M University, the U.S.D.A. Forest Service, the University of Georgia, the University of the West Indies and Yale University. The director of the Archbold Tropical Research Center was hired in late September 1989. Even though the center still is young, a great deal has been accomplished. This report summarizes progress over the past year of operation.

Facility Maintenance and Improvements

All major buildings have received improvements, many of them major. The guest house in particular has had many repairs. The front veranda has been replaced as has the southeast facing wall. A new freezer and a new stove were purchased for the kitchen. New chairs were purchased for the dining hall.

A new balcony was built for the apartment complex and repairs were made on the bathrooms. We are still renovating the old staff quarters into graduate student housing. Both the apartment building and the guest house have been completely repainted.

The Stream House floor was replaced in the front bedroom and the foundation is being repaired. The entire first floor is being remodeled for dormitory use. Bunk beds, mattresses and pillows have been purchased for all the bedrooms. The Bee House has received only minor repair, since it is in fairly good condition. Mt. Joy has received extensive renovation. The entire basement area has been closed off and converted into a field laboratory. Extra showers and toilets also have been installed. Bunkbeds, mattresses and pillows were purchased to accommodate the students.

We also have improved the roads to Mt. Joy and the Bee House, and we have improved the trail system throughout the property.

The agricultural lands have been given special attention, and the citrus has been brought back into production. We also are enhancing the coffee, cacao and coconuts and hope to have them in production soon as well. We currently grow much of the produce that we use in the kitchen (fruits and vegetables).

We have begun to obtain new equipment for the station as well. A new 10-passenger van was just purchased. The Smithsonian Institution donated herbarium cases to the center. The U.S. Forest Service and The National Park Service also have donated laboratory equipment. Clemson University sent down a Zenith Super-sport laptop computer and an Epson dot matrix printer.

Expansion of Consortium Membership

Penn State University this year became the first new member since the charter membership. We now are negotiating with two additional potential members: the University of Maine and the University of Oklahoma. The director will be visiting both institutions by their invitation to negotiate membership. Bradford University, from Bradford, England, visited the Springfield Field Station in April 1991 to consider joining the consortium. They would be our first European member.

In order to expand the scope of research opportunities available to consortium members and to provide for a network of exchange of information on issues relating to tropical ecology and biodiversity, the Archbold Center has created a program for Latin American affiliate members. Latin American members to date are: the

Universidad Nacional Autonoma de Mexico (Mexico City); the Universidad del Cauca (Popayan, Colombia); the Universidade de Brasilia (Brasilia, Brazil); the Universidade Federal de Minas Gerais (Belo Horizonte, Brazil); the Centro de Pesquisa Agropecuaria de Pantanal (Corumbá, Brazil); and the Centro Regional de Investigaciones Cientificas y Tecnologicas (Mendoza, Argentina). We currently are negotiating with The Universidad Nacional (Heredia, Costa Rica) and The Universidad Nacional de Tucuman (Argentina). A future plan is to hold a conference on *Biodiversity in Latin America* with the participation of our Latin American members.

Use by Nature Tours and Classes

The Springfield Field Station began making the facility available for classes and organized nature tour groups in early 1990. Use increased more than two-fold in 1991, and several classes have been booked for 1992. We hope to eventually offer between 10 and 15 classes and nature tours every year at the Field Station. Below is our record of use to date.

| | | |
|---|----------------------------|-------------|
| American Forestry Association | Feb. 7-13, 1990 | Nature Tour |
| Clemson Alumni Association..... | March 19-29, 1990 | Nature Tour |
| Texas A&M University..... | May 29-June 16, 1990 | Class |
| Texas A&M Alumni Association..... | Feb. 10-16, 1991 | Nature Tour |
| SUNY-College of Environmental Science and Forestry | March 2-10, 1991 | Class |
| University of Maine | March 4-16, 1991 | Class |
| Clemson Alumni Association | March 13-20, 1991 | Nature Tour |
| Texas A&M University | May 24-June 18, 1991 | Class |
| National Museum of Natural History..... | June 19-July 7, 1991..... | Class |
| University of Missouri Kansas City | June 24-July 8, 1991..... | Class |

Use by Governmental and Non-Governmental Organizations

During the past twelve months we have encouraged both governmental agencies and non-governmental groups to use the facilities at Springfield for meetings, conferences and workshops. This has become a very successful program, and we anticipate increasing use of the facility for these purposes in the future. Below is our record of government and NGO use.

| | |
|--|---------------------|
| Caribbean Forest Research Institute | July 1990 (1 week) |
| Caribbean Peace Corps | Sept. 1990 (1 week) |
| Small Island Project Assistance Team | Nov. 1990 (10 days) |
| Waterfront and Allied Workers Union | Nov. 1990 (4 days) |
| Dominica Tourist Board | Nov. 1990 (2 weeks) |
| Caribbean Forest Research Institute | Dec. 1990 (10 days) |
| Pan American Development Foundation | Feb. 1991 (1 week) |

Research Visits to Springfield Field Station

The initiation of research activities at the Springfield Field Station is expected to lag behind other uses due to the time involved in preparing and submitting proposals. As an indication of research interest on the island, however, we have had a large number of visitors to Springfield to make site visits to assist in the preparation of proposals. Several other studies already are under way. A summary of research-related activities follows.

| Visitor/Group | Purpose | Year |
|-----------------------------------|--------------------------|------|
| Archbold Center Board | Visit center/island..... | 1989 |
| Dr. Steve Hill, Clemson Univ..... | Botanical Research | 1990 |

| | | |
|--|---------------------------------|------|
| Dr. Gail Noblet, Clemson Univ..... | Parasitology Research | 1990 |
| Dr. Ray Damian, Univ. of Georgia..... | Parasitology Research | 1990 |
| Dr. Allen Drew, SUNY-ESF | Site Visit-Forest Ecology | 1990 |
| Dr. Susan Jewett, Smithsonian | Site Visit-Ichthyology | 1990 |
| Dr. Dan Neary, USFS | Watershed Research | 1990 |
| Dr. Jerry DeGraff, USFS | Watershed Research..... | 1990 |
| Dr. Steven Hill, Clemson Univ. | Botanical Research | 1991 |
| Dr. Graham Brister, Univ. of Georgia..... | Forestry Research | 1991 |
| Dr. K. Steinbeck, Univ. of Georgia | Forestry Research | 1991 |
| Dr. Peter Hannah, Univ. of Vermont | Forest Ecology..... | 1991 |
| Ms. Constance Stubbs, Univ. of Maine | Lichen Research | 1991 |
| Dr. Frank Wadsworth, USFS | Forestry Research | 1991 |
| Dr. Steve Jones, Clemson Univ. | Forest Ecology | 1991 |
| Mr. Wes Dixon, Clemson Univ. | Forest Ecology | 1991 |
| Dr. Mary DeChesnay, Clemson Univ. | Public Health Research | 1991 |
| Dr. John Kelly, Clemson Univ. | Horticulture Research | 1991 |
| Dr. Joe Tomasso, Clemson Univ. | Aquaculture Research | 1991 |
| Dr. Arnie Eversole, Clemson Univ. | Aquaculture Research | 1991 |
| Carnegie Museum of Natural History | Entomology | 1991 |
| Dr. Brian Davis, Bradford Univ. | Environmental Research | 1991 |
| Dr. Bobby Wixson, Clemson Univ. | Environmental Research..... | 1991 |
| Mr. Stephen Voigt, Univ. of Vermont..... | Vertebrate Ecology | 1991 |
| Dr. Kelly Mayo, MUSC..... | Public Health..... | 1991 |
| Univ. of Pennsylvania Research Team..... | Ornithology | 1991 |
| Dr. Ed Ruppert, Clemson Univ. | Ecology..... | 1991 |

Several research proposals were submitted or are currently in review. The most significant was our proposal to the MacArthur Foundation for support of a research and professional development program in the East Caribbean, based at Springfield. Although we did not receive funding, the proposal was well received by Dr. Dan Martin at MacArthur, and he encouraged a resubmission. Mr. Alexander also is working closely with USAID, the OECS, the Pan American Development Foundation and Dominican government agencies on several research opportunities. A proposal is in preparation in conjunction with the U.S. Forest Service to conduct training programs at the Springfield Field Station (approximately \$400,000).

Research at Other Tropical Sites

Brazil: The director of ATRC received a Provost's Research Award to visit Brazil to continue research activities on the ecology and conservation of the Brazilian savannas. While in Brazil, he will meet with the three affiliate members of the ATRC consortium (Federal University of Minas Gerais, University of Brasilia and Center of Agricultural Research in the Pantanal) to plan future research activities.

Costa Rica and Panama: ATRC and Conservation International will jointly manage a major research initiative on conservation, reforestation and land management in the Pacific region of Costa Rica and Panama, sponsored by the McDonald's Corporation. McDonald's has committed \$500,000 to the project, and ATRC, CI, and McDonald's already are working together to secure an additional \$3 million in support. We have met with representatives of the World Bank and USAID to discuss financial assistance, as well as with members of the Costa Rican business community. These meetings have been very positive, and we are optimistic about meeting our goals.

In addition, ATRC and the Universidad Nacional in Costa Rica have submitted a proposal to USAID (\$150,000) to fund a GIS study of the conservation network in Central America. RRDI will be an active participant in this project.

ACADEMIC AFFAIRS

Clemson University Libraries

Services

The exploding base of information has made it impossible for any library to be able to acquire for its permanent collections all the materials needed. Therefore, the use of technology is moving libraries away from serving as storehouses of books and journals to primary access points for the world's information. Services are becoming more and more critical in Clemson University Libraries as well as the other research libraries in the world.

The Clemson University Libraries have been a forerunner in the development of information technology with the integration of vendor on-line searching, CD ROMs, locally mounted databases and document delivery systems into its reference service. Each year more and more information is accessible to users from remote locations. Inter-library loans, document delivery services and referrals complete the service components by delivering the full-text information needed. During 1990-91 the inter-library loan activity continued its dramatic increase. The inter-library loan staff handled 12,417 borrowing requests and were able to fill 10,245 of them. Further, they received 13,400 requests to supply materials to users at other libraries and were able to fill 7,876 of them.

The Libraries were chosen as one of 15 land-grant libraries nationally to participate in the Text Digitizing Transmission Project. This project is designed to test the feasibility of scanning printed pages and transmitting digitized information to other libraries in lieu of fax machines. Text digitizing and transmission have several advantages over Group 3 fax machines; it provides better copy at the receiving end, the receiver can retain the information in digitized form for later use, and it can be done using The Internet to eliminate transmission costs. The project will identify the problem areas and those things which have to be done to make this a feasible and desirable means of transmitting information.

A major aspect of any academic library is the instruction of its users, primarily undergraduates, in the world of information retrieval. The emphasis in the Libraries, through its Reference Unit, is the teaching of library skills to develop life-long users of libraries. During the year the library faculty taught more than 6,500 students in its bibliographic instruction program. To assist in this effort a new video tape program was introduced which provides students a quick "tour" of Cooper Library. Further, two Provost Teaching Grants were awarded to library faculty; one for the creation of a Hyperbook, a computer-assisted instruction program and the other for the development of a comprehensive four-year instruction program for architecture students.

DORIS, the Libraries locally mounted database system which provides bibliographic and full-text data, continued to grow during 1990-91. Two bibliographic and one full-text database were added to the list of such databases now available through DORIS. The two bibliographic databases, Social Sciences Index and Humanities Index are major indexes in the library field and are heavily used by undergraduates. The full-text database added was the Grolier Academic American Encyclopedia. The dramatic increase in the use of these resources can be seen from the comparison of the 47,606 "connects" this year with the 23,778 last year. This doubling of connects can be attributed in part to the additional databases, but the primary reasons for the increase are the popularity with the students and its availability from remote locations.

Do-it-Yourself Searching, a service which permits users to do their own searching on databases located remotely at a commercial site, continues to be the most popular service with our graduate students. This service complements the DORIS system by providing access to databases which are not practical to load on Clem-

son's computers because of their size and/or annual cost. During 1990-91, 2,363 searches were made on Do-It-Yourself Searching.

A new datafile, LUDI, was created to house the bibliographic records of government documents acquired from MARCIVE. This datafile was made available to reference librarians to assist patrons in the location of government documents. This datafile also is also being used to acquire bibliographic records of government documents housed in our library and move them into the Libraries' main catalog, LUIS. This is the beginning of a multi-year project which eventually will have all of the government documents holdings reflected in LUIS. Another benefit will be the availability the check-in records of document serials online.

Our Public Documents Unit bears the responsibility for the Libraries' designation as a Shared Regional Depository Library. Part of the responsibility of a Regional Depository is the supervision of the Selected Depositories in the state. Since we are a "shared" regional depository, we share this responsibility with the library at the University of South Carolina in Columbia. One of the responsibilities of supervision of selective depositories is to manage the disposal of government documents from the selectives. Clemson University Libraries have completed the first round of such activities with the selectives it supervises.

Our Circulation Unit was responsible for the addition of several new services. These included the installation of book return units at two remote locations (Student Union and Byrnes Hall) as well as a unit close to the West parking lot next to Cooper Library. These units provide users with more convenient means of returning library books. These return units are serviced by the same staff who deliver and pickup materials from the faculty's departmental offices. This document delivery service, a part of the relatively new EDDIE program, has increased in usage greatly during the year.

A number of other measures were taken to increase the availability of the Libraries' collections. These included improving the maintenance of our stacks, billing patrons for items more than 30 days overdue and revising our loan periods. The most dramatic changes in loan periods were for faculty — from one year to three months — and graduate students from one semester to six weeks.

One of the greatest accomplishments of the year was the successful negotiation with Student Government to "buy out" their "concession" for the provision of photocopier service in the libraries. For a number of years the Libraries have been working with Student Government to improve these services. Finally we determined that the only way to improve these services permanently and to reduce the rate of cost per copy was to operate them ourselves. At the end of the fiscal year we concluded our negotiations and on June 28 formally took over the operation of the copiers.

Our Reserves and Media facility experienced a dramatic increase in usage, reflecting the increase in student body size as well as the addition of new forms of media which included video tapes and music recordings. The Libraries assumed responsibilities for the operation of the Music Library, and the recordings and equipment were located in our Reserves and Media facility.

A high priority was given to the shelving of current periodical issues on the day of receipt to increase their accessibility.

Our Architectural Library experienced an increase of more than 21 percent of users. It also had an increase of 14 percent in the circulation of materials from that facility.

The Records Center, an operating arm of the Special Collections Unit, had some significant personnel changes. On the positive side, Mr. Isaac Wallace joined the staff as records manager, and on the negative side, the center lost the services of Mr. Ron Williford for an extended period due to illness. During the transition Ms. Lauren Young did a commendable job of overseeing the functions and operations of the Records Center. The staff continued toward their goal of completing the physical inventory of the entire University records. Based on the current situation, completion is projected for 1995. A significant number of campus agencies were visited

for the physical inventory, and a number of those had retention schedules developed and approved. During the year the center staff embarked on a new effort, the inventorying and scheduling of electronic records. They worked with the leadership and staff in DAPS in this effort. Clemson certainly is leading the state in this effort with electronic records.

A major part of the Records Center's efforts is to ensure that the agencies and units within the University do not retain records longer than necessary to increase space utilization and more efficient operation of these units. Therefore, the staff spent a good portion of its time on disposing of records and implemented additional recycling procedures. More than 83 percent of records scheduled for destruction were recycled. Records considered to be confidential continue to be shredded.

Eight major exhibits were prepared and installed under the Exhibits Program during 1990-91; two of these were in cooperation with other campus departments.

The Libraries have continued to assume responsibility for inventorying those items deemed to be a "rare possession" of the University. A special effort is under way to verify the location of all of these items as well as to consult with holding departments on the correct means of preservation of the items.

Collections

The major impact on the collections has been the continued inflation of periodical subscription prices. We experienced a 15 percent increase during 1990-91 which amounted to more than \$200,000. These funds had to be recouped from other budgets within the libraries, with the end effect of reducing the number of items we could add to the collections. While the projections for the upcoming year are nearly the same, the actual decrease in our budget will force a cancellation project. In fact, during 1990-91 such an impact was predicted, and a process for the selection of periodical titles which will be canceled was initiated. The process involves the participation of faculty in the selection of titles to be canceled.

In spite of the above we were able to add 7 percent more items than in the previous year. This figure includes items purchased and donated.

The move of the Music Library to Cooper Library resulted in the initial cataloging of 36 cds and 191 music scores. As this project is completed the access to the music scores and recordings will be improved.

The University Archives continued its work of preserving the University's history. A great deal of energy and effort was focused on five large series of the Cooperative Extension Service, two of which were opened for use. The records of the Cooperative Extension Service represent the best primary source for documenting changes in S.C. agriculture during the 20th century. During the year 70 new accessions were made of University materials. In addition to the Extension Service series, several other series were opened to users. These included the biographical files of the University Relations Department and the records of the University Athletic Council.

Slide cataloging project continued to make progress. Test records were developed and refined and evaluated by cataloging staff members. When the bibliographic records as well as labels and barcodes are completed and entered into LUIS for the entire slide collection housed in the Architectural Library, it will be much easier to identify and locate slides. One of the first steps toward this end has been the reorganization of slide collection with a new classification system. This project was completed during the year.

ICPSR (Inter-University Consortium for Political and Social Research) manuals and codebooks which relate to the computer datatapes located in the Computer Center are being cataloged and housed in the libraries.

Through a combination of purchases and depository receipts, our map collection now has virtually complete coverage of the U.S. in an up-to-date map series that is appropriate for most uses. In addition we continue to receive the more detailed "Topo Quad" maps for the Carolinas, Georgia and Tennessee.

Holdings information for almost all of the experiment station publications for 25

states have been made available on LUIS, and on-line check-in of newly acquired issues now is taking place.

A full-time professional archivist was added and this has revitalized the processing of manuscript collections. Manuscript collections consist of primary materials which are not considered University records. Examples of collections receiving attention this year were those of the Textile Hall Corporation, the papers of the Foot-hills Sierra Club and the papers of J. Fred Buzhardt, Jr. A major collection continuing to be processed is that of Sen. Strom Thurmond. A significant project in this area is the indexing of his speeches. Preliminary work began on the cataloging records for this material. Another major breakthrough with the Thurmond Collection was the agreement by the S.C. Department of Archives and History and the Caroliniana Collection of the University of South Carolina to permanently transfer to Clemson their records documenting Sen. Thurmond's gubernatorial years. In turn we have promised to have integrated all the Thurmond gubernatorial papers and produced a microfilm edition of the papers by 1995.

Facilities

The Gunnin Architectural Library was recarpeted, a project which required the removal of materials from shelves in July. By careful planning and work by the Architectural Library staff, this work resulted in minimal inconvenience to users. What was formally the Architectural Librarian's Office was made into a public media facility, and the former Rare Books area was converted into an office for the architectural librarian.

In Cooper Library the reshelving of documents collections was undertaken to provide improved access to S.C. documents and to make it easier to give directions to federal documents. All of the S.C. documents have bibliographic records in LUIS, which also improves their access. As a result, the use of these documents continues to increase.

One of the driving forces behind a host of decisions being made in the Special Collections Unit is the need for additional space. This is a deciding factor in the determination of which collections to process first. Those which have the greatest amount of materials to be discarded are given higher priority. Concurrently, efforts at the library administration, the president and at the board level are being made to secure a gift which would greatly assist in the acquisition of mobile shelving for the Special Collections stacks area. This area, located in the Strom Thurmond Institute Building, was designed for mobile shelving to provide adequate space for existing and future collections. Because of a shortage of funds during construction the mobile shelving was eliminated and fixed shelving purchased. The impact was more than a 50 percent reduction in shelving space. As a result the facility already has reached capacity. Unless funds are secured soon for mobile shelving, it is realistic to expect the libraries to have to decline some very important collections because of lack of space to house them.

Fund Raising

The Libraries held its First Annual Book Fair Sept. 21-22, 1990. More than 4,000 books were sold, resulting in a net profit of \$2,666. The books sold were books donated to the libraries, but deemed inappropriate for addition to our collections. The Book Fair was so successful because of the hard work by many of our staff who were led in this effort by Steve Johnson.

The Library Friends annual mailer was again a major source of annual donations for the libraries. During 1990-91 we had 319 donors who gave a total of \$29,794.

Through the Special Collections Unit, the Libraries applied for and were awarded a grant by the National Historical Papers and Publications Commission for the purpose of organizing and preserving the records of a number of S.C. textile companies, many of whom no longer are in business. In the grant the NHPRC will pro-

vide \$71,680 for this purpose, and the College of Commerce and Industry is providing \$15,190 toward a match, with the total project budget being more than \$226,000.

Staff

For the first time in its history the annual meeting of the American Library Association was held in Atlanta within easy driving distance to Clemson. Because of this close proximity the Libraries provided daily van service to the conference for members of the classified staff who rarely get an opportunity to attend one of these meetings. The van shuttle was extremely successful. The many staff who used this service to attend the conference got a new perspective on librarianship as a result of participating in a conference with 14,000 others whose interest is libraries.

Three different groups within the Libraries submitted Poster Session ideas for presentation at the annual conference of the American Library Association in Atlanta this summer, and all were accepted. Representatives of the Libraries' Staff Council presented poster sessions on their organization; two staff members presented a poster session on the Libraries' document delivery system, EDDIE, and our On-line Coordinator presented a poster session on the Libraries' and Computer Center's INFO EXPO held last year. All the sessions were well attended with a great deal of questions and expressions of interest generated. All of our staff participating in these sessions are to be congratulated on being accepted and for doing an outstanding job of making their presentations to librarians from all across the country.

Peggy Black celebrated her 40th year working in the Library Cataloging Unit. The Libraries also had one retirement from its faculty: Ms. Myra Armistead retired effective June 30, 1991, after 25 years of service. Toward the end of the year Mr. Richard Meyer, the associate director, announced that he had accepted the position of director of libraries, Trinity University, San Antonio, Tex. Both Ms. Armistead and Mr. Meyer have made numerous contributions toward the success of the libraries and will be missed.

This year was highlighted by the staff effort in our technical services area to merge two units, the Monograph Acquisition Unit and the Serials Acquisition Unit. A head for the combined unit was employed, and under her direction and that of the coordinator of technical services, the planning was completed for the merger.

The Libraries were fortunate to have three of its faculty receive Provost Teaching Grants for two instructional projects in the libraries. Deborah Johnson, head, Architectural Library, received a grant to develop a four-year library instruction curriculum for architectural students. Ms. Lorrie Evans and Mr. Ken Murr were successful in their grant application for funds to create a Hyperbook for computer assisted instruction in the use of the Clemson University Libraries.

Library Statistics - 1990-1991

COLLECTIONS

| Books/Journals | Accessioned | Withdrawn | Net Added | TOTAL |
|------------------------------------|--------------------|------------------|------------------|----------------|
| Cataloged | 27,546 | 1,170 | 26,376 | 733,730 |
| Uncataloged | | | | 2,519 |
| Total | | | | 736,249 |
| Documents and Reports | | | | 679,454 |

| Microforms | Microfilm | Microfiche | Microcard | Vol. Equiv.* |
|---------------|---------------|------------------|---------------|----------------|
| Public Docs | 1,523 | 1,130,294 | 0 | 114,552 |
| Other | 22,694 | 578,202 | 31,499 | 83,664 |
| Totals | 24,217 | 1,708,496 | 31,499 | 198,217 |

GRAND TOTAL - PRINTED MATERIALS **1,613,920**

* Microform volume equivalents are determined by counting microfilm reels as one volume and ten microfiche or microcards as one volume.

| | |
|-------------------------|---------------|
| Slides | 80,570 |
| Maps | 18,439 |
| Videotapes | 283 |

| Current Subscriptions | 1989-90 | 1990-91 |
|-----------------------|--------------|--------------|
| Periodicals | 6,106 | 6,132 |
| Other Serials | 1,087 | 1,082 |
| Totals | 7,193 | 7,214 |

CIRCULATION

Door Count of Users

| | | |
|---------------------|----------------|----------------|
| Cooper | 839,300 | 912,687 |
| Gunnin | 80,059 | 80,059 |
| Totals | 919,359 | 992,746 |

Books Circulated

| | | |
|---------------------|----------------|----------------|
| Cooper | 212,883 | 252,894 |
| Gunnin | 27,527 | 23,236 |
| Totals | 240,410 | 276,130 |

REFERENCE SERVICES

Inquiries

| | | |
|---------------------------|---------------|---------------|
| Reference Desk | 61,661 | 59,600 |
| Telephone Reference | 1,795 | 1,382 |
| Liaison Reference | 2,593 | 3,062 |
| E-Mail Reference | 2 | 24 |
| Totals | 66,051 | 64,068 |

Computer Connects for Searches

| | | |
|----------------------|---------------|---------------|
| Quick | 6 | 2 |
| Do-It-Yourself | 1,834 | 2,363 |
| Reference | 210 | 62 |
| Research | 128 | 106 |
| DORIS | 23,778 | 47,606 |
| Totals | 25,956 | 50,139 |

Interlibrary Loans

| | | |
|---------------------|---------------|---------------|
| Loaned | 7,112 | 7,876 |
| Borrowed | 8,049 | 10,245 |
| Totals | 15,161 | 18,121 |

Computing and Information Technology

Computer Center

In 1990-91 the University's mainframe computing systems were able to keep pace with the increased demand for computer services, both on and off campus. The mainframe computer, installed in May 1990, did not experience a single failure, thus continuing a record of reliability on which the University and the state have come to rely.

The growth in mainframe computing is largely in the areas of research and administrative support. This is expected to continue to be the case as classroom applications migrate to the VAX network of computers or to desktop machines. Both research and administrative computing are, however, increasing faster than other academic mainframe computing is declining, and outside computing shows no signs of slowing down, so overall mainframe usage continues to grow at a rapid rate. Information systems supporting the Library are particularly demanding of resources and promise to be a major growth area indefinitely. The increase in the number of on-line administrative database systems accessible by the Clemson community also is putting increasing pressure on available computing resources.

Use of the VAX network for academic and office automation applications also is growing rapidly. The increasing popularity of the UNIX operating system for academic users maintained on the VAX network has required a substantial investment of additional resources. Demand for UNIX services also is expected to increase indefinitely, with administrative applications also being developed under UNIX at some time in the future.

As microcomputers become ever more integrated into the University curriculum, the problem of providing a sufficient number of publicly accessible workstations becomes increasingly severe. The Computer Center is attempting to set up a small number of large microcomputer laboratories to supplement those already in place. Providing the funding to supervise a large number of small laboratories is becoming too onerous, and a smaller number of large facilities would be more efficient. The problem with this approach is finding the space. Nevertheless, the number of publicly accessible workstations continues to increase, and the older workstations are being replaced on a regular schedule.

Computer Center funding remains a controversial issue. Discussions still are under way to attempt to address the issue of how to provide additional funding for the increased level of computing support expected by all segments of the University community. The pressures on the center to adjust its service focus to maintain a certain level of outside revenue also is of continuing concern.

The Computer Center never has featured in the strategic planning of the University. Center management and staff are working to rectify this situation by including the center's strategic plan in the material considered by the University's new Strategic Planning Committee. It is hoped that this will result in the study and resolution of some of the long-standing computing issues referred to in this and previous annual reports.

Information Systems Development

Information Systems Development (ISD) is a self-supporting group within the Division of Computing and Information Technology providing information technology services to organizations outside the University. Despite the recession and the shortfall in state revenues, ISD has maintained its level of contract support and is moving into 1991-92 with a solid base of contracts for the next several years.

Services to state agencies still account for the majority of ISD revenues, but now, for the first time, ISD has major contracts with non-state agencies, giving much-needed diversity to the contract base. The two most significant of these contracts are with Arthur Andersen Associates to assist in the development of a Title IV-D Child Support Enforcement System for the State of Texas and with Storage

Technology Corporation of Boulder, Colo., to develop and market a mainframe software package to manage the operation of a tape-mounting robot.

ISD's contract to provide support for South Carolina's Medicaid Management System has been renewed for a further three years with two, one-year extensions. Assuming it goes its full term, this contract at \$20.5 million will be twice the size of any other contract previously obtained by the University. This, together with numerous other contracts supporting such agencies as DHEC, the Department of Corrections and the Technical College System, point to a rosy future for ISD.

The success of the tape robot project has led to the formation of a research and development group within ISD. While ISD's traditional activities in providing major database systems for state agencies will continue, it is expected that R&D ventures will increase in number and in scope, thus maintaining ISD's alignment with the strategic goals of the University.

Administrative Programming Services

During 1990-91 Administrative Programming began a major thrust to introduce relational databases technology to large administrative systems. As a first step the systems that support Institutional Advancement were redesigned to provide many additional features and to use a new release of our database software that provides relational support. This will provide for a smooth, cost-effective migration to this technology, providing faculty, staff and students easier access to University information systems.

Even though a decision to purchase several business systems was pending, significant progress was made in the introduction of electronic business forms, particularly in the comprehensive purchasing system installed during the year. Electronic forms replace corresponding paper documents and allow for quick approval and routing of documents over the computing network. Several new applications of electronic forms will be phased in during the next few months.

Administrative Programming intensified its efforts to provide services directly to all members of the campus community through various information systems. For example, students now have access to all aspects of their academic and financial records. Employees can review their position information and, in some cases, request leave with electronic documents. At present there are 17 databases, in addition to the on-line catalog, in the Library information system accessible from all points on the computing network.

With the advent of a formal University planning mechanism, it is evident that Administrative Programming must serve as a focal point for strategic information systems planning. Although the University encourages budget centers to initiate their own systems and networks, there remains a core of information databases and systems that must provide consistent, standard and reliable support across all areas. The challenge in the coming year will be to insure that the information systems infrastructure remains strong and meshes effectively with overall University planning.

The Graduate School

The 1990-91 academic year saw approval by the Commission on Higher Education of five new degree programs with starting dates as indicated: the professional master's program in Human Resources and Development (fall '91), the M.S. in Applied Sociology (fall '91), the M.S. and the Ph.D. in Materials Science and Engineering (fall '91), and the professional master's program in Public Administration (fall '92). The last degree program is offered jointly with the University of South Carolina through the Greenville Higher Education Consortium. The commission also granted approval to offer the existing MBA program at locations in Pordenone, Italy and Munich, Germany. Four additional new degree program proposals were approved by the University Graduate Curriculum Committee and have been forwarded to the commission for final approval.

Completed applications for the 1990 fall semester totaled a record 4,006, an increase of 7 percent. Forty-three percent of the pool of applicants was accepted, resulting in 886 new enrollees. Total enrollment equaled 3,573 including 1,462 full-time students, 1,715 females and 542 internationals.

Graduate degrees awarded in the period August 1990 - May 1991 totaled 850; 776 master's, one specialist and 73 doctorates.

Certification of competency in English for all international graduate assistants involved with instruction took on a more standardized and centralized approach. The Department of English was given authority, beginning in August 1991, to administer the SPEAK Test to all new international graduate assistants. Recommendations are forwarded to the Graduate School and the respective departments.

The National Dropout Prevention Center

Since its founding in 1986 The National Dropout Prevention Center (NDPC) has attempted to significantly reduce America's dropout rate by developing business-education partnerships between local school districts and communities across the nation. The center emphasizes four primary areas to attain its goal and collaborates with many local, regional and national organizations.

Before individuals can act they must first become cognizant of a problem and its consequences. The NDPC has taken several approaches to *increasing awareness*. During the 1990-91 school year the center collaborated with many national and regional organizations such as the U.S. Department of Labor, Cities in Schools, and The National Association of Partners in Education to cosponsor workshops and to participate in forums or other outreach activities. Center staff also worked very closely with the U.S. Army to create a video intended for students. "Tough Decisions" examines quitting school from the dropouts' perspective. Five young people candidly discuss their reasons for leaving and the effect it has had on their lives and the lives of those around them. The video was so successful that the Public Relations Society of America awarded it a Silver Anvil. Additionally, NDPC staff accepted invitations to speak to 50 civic and local groups about the issue of dropout prevention.

Once aware, the public then must have *access to information* that can generate action. The NDPC compiles and disseminates information related to all aspects of dropping out of school—legislative initiatives, economic/social costs, the latest research, literature and proven dropout prevention programs.

The primary vehicle for this operation is the FOCUS database which consists of five subfiles that contain information on programs, conferences and the most up-to-date research available. FOCUS is available world-wide and has been expanded this past year to include two additional subfiles. The Organizations file lists many groups involved with at-risk youth. Entries consist of names, addresses, contact data and descriptions of each. The Consultants and Speakers file is designed to help users locate individuals with experience in specific areas that can enhance local efforts. Each listing includes the consultant's name, qualifications, contact information and area of expertise. All FOCUS data are updated regularly to maintain viability and usefulness. The NDPC also maintains a resource materials library of abstracts, topical journals, magazines, articles, research reports and curricula which also is accessible through the FOCUS database. Fifty to 75 new titles are added each month. The library is open to on-site use by University students, faculty, school administrators and educators, as well as any interested visitors and is used frequently.

The center also provides a wide variety of *technical assistance* to educators, administrators, counselors, corporate leaders and policymakers. Since its beginning the NDPC has sought ways to help public schools. One of the most critical needs is the ability to develop funding proposals. Schools in South Carolina and across the nation have received funding as the result of center staff working with school em-

ployees on proposal development, writing and submission. To date, more than \$3 million has been awarded to schools which received help from the center.

At-risk students in local education agencies also benefit from center staff time and expertise. Anderson (SC) School District One with NDPC assistance implemented a district-wide tutoring program that recruited and utilized local volunteers. More than 700 potential dropouts were tutored by 412 volunteers from schools and the community. The amount of homework returned to teachers increased, absenteeism decreased, as did discipline referrals. The Tutoring Success Program was so successful that it has become an integral component of the overall dropout prevention effort for District One.

The NDPC also helped in the development, evaluation and replication of the Adopt-a-Cub Program. This is an after school program that matches older students with elementary students. High school students assist the younger at-risk students with their homework and generally lend a helping hand. Last year approximately 125 students participated. At the NDPC's suggestion, Adopt-a-Cub applied for and obtained funding from Clemson's Visions for Youth Project. Visions staff were so impressed with the project that they are planning to replicate it at various sites across South Carolina.

The center also has become a credible source for the media, especially on legislative issues. The center is usually one of the first agencies contacted for story ideas and sources and has experienced an increase in the number of calls from the media every year since its founding. The U.S. Department of Education frequently refers reporters to the center for the most up-to-date information on dropout programs, statistics and policies. Staff members regularly confer with representatives from major national and international corporations such as Burger King and Boeing Co. who want to become actively involved in dropout prevention efforts. NDPC staff also share their various expertise by sitting on four South Carolina, six national and six local advisory boards or committees. Regular workshops, conferences and seminars permit the center to assist educators in acquiring and updating their skills. To date, more than 7,000 individuals across the nation have benefited from these activities.

Finally, the NDPC engages in *action research* to validate and develop solutions and strategies that make school a place in which students are eager to learn. Chief among these efforts are the Lifelong Options Program (LOP) which combines vocational education with academic instruction. Operating in three states (Maryland, Florida and South Carolina), LOP offers potential dropouts a chance to earn a high school diploma as well as acquire valuable work skills and experiences that ensure future success. A video about the project has been produced and distributed to vocational education directors in every state. LOP is changing the education of at-risk youth. Preliminary evaluation reveals that at-risk students at LOP sites are increasing their rate of attendance, acquiring more credits toward graduation and are earning higher marks than before. Within the next year educators will have a comprehensive manual to incorporate LOP's methods into their own school systems.

Another ongoing project of the NDPC is the Clemson CROSSROADS program. CROSSROADS is a mentoring program which matches University faculty, staff and students with at-risk middle and high school students. Its goal is to provide students with adult role models and to expose at-risk youngsters to different academic and career options. Preliminary data showed students improved in the areas of grades, self-esteem, attendance and discipline. Many spent time on the job with their mentors and discovered potential job and educational opportunities.

In addition to publishing its own findings, the center seeks out others engaged in research and distributes their findings through various NDPC publications. In the past year documents have been produced on alternative education, funding, mentoring, tutoring, incentives and self-esteem.

The National Dropout Prevention Center presently is in the process of restructuring. A national Council of Advisors has been named and includes such individuals devoted to educational quality as Martin Luther King, III and Walter Anderson

of *Parade* magazine. The center also has been closely affiliated with the National Dropout Prevention Network since 1986. This relationship has benefited both organizations. Their goals are similar: to help improve the skills of those working with at-risk students by providing the most current information on dropout prevention practices and policies. One result of this collaboration is an annual national conference that regularly attracts a audience of between 1,500 to 2,000. Conference participants range from practitioners to researchers to policymakers. The 1991 Tulsa Conference featured more than 100 different workshops and speakers such as noted columnist William Raspberry and country music star Waylon Jennings who recently earned his GED.

The National Dropout Prevention Center falls under the Office of the Provost of the University. In keeping with the University's tradition of public service, the NDPC takes seriously its obligations to the citizens of South Carolina and the nation.

The Strom Thurmond Institute

The Strom Thurmond Institute is the University's flagship public policy organization. It is dedicated to the principle that broad access to knowledge and a free exchange of ideas will result in more effective government. The institute, therefore, sees as its purpose the promotion of awareness of public policy issues among citizens and the promotion of interest in public sector problem solving throughout the University's teaching, research and public service activities.

The institute accomplishes its mission through three major avenues: Public Policy Programs, Public Events and Lecture Series and a Publications Program. The scope of the Strom Thurmond Institute's programs is national and international, but its focus is on South Carolina. Furthermore, as a public policy center for a land-grant University, the institute will continue to place emphasis on rural development policy issues in South Carolina.

Public Policy Programs

The Public Policy Programs at the institute have involved many areas of domestic and foreign policy. During 1990-91 the major areas of emphasis were Asia Studies, Economic Policy, Energy Emergency Planning, Engineering and Technology Policy, and State and Local Government Policy. Other research and public service activities in which the institute has been engaged in the past include water policy, defense studies, comprehensive land-use planning, taxation policy, county needs assessments, geographic information system development and municipal incorporation.

Asia Studies: For several years the institute has maintained an interest in developing opportunities for cooperative ventures with universities and other organizations in Asia. During the past year and continuing into the present, plans were laid for cooperative ventures with institutions in the Republic of China (Taiwan), the People's Republic of China and Japan. Activities included a visit by the vice chancellor of National Chiao Tung University in Taiwan; a lecture by Mrs. Anna Chennault, wife of the late Gen. Claire Chennault, leader of the Flying Tiger squadron in China in World War II; and planning for a joint U.S.-Japan conference in 1992 to promote collaboration in research and economic development. In addition during 1991-92 Professor Emeritus and Senior Fellow Clinton H. Whitehurst, Jr. will be a visiting professor for the second time at National Chiao Tung University.

Economic Policy: In 1990-91 the Strom Thurmond Institute initiated the Economic Outlook Project. This program, directed by institute director Bruce Yandle, focuses attention on the national, regional and state economies through a series of Economic Outlook Conferences, regular reports on the economic situation, columns

for newspapers and special programs presented to business and civic groups and public sector organizations throughout the country.

The Economic Outlook Conferences this year featured Bethel Minter, chief economist of SunTrust Bank; Jim Boehm, director of short term forecasting for General Motors; former OMB Director James C. Miller III; and David Wyss, senior vice president of DRI-McGraw Hill. Approximately 125 people attended each conference.

Other activities included a lecture by Velma Montoya, commissioner, Occupational Safety and Health Review Commission, and more than 40 public presentations on the economic situation to groups in South Carolina and around the country.

Energy Emergency Planning: The institute continued to work with state energy offices throughout the United States on energy emergency preparedness and planning.

During 1990-91 the institute completed contracts with the states of California, Hawaii, Louisiana, Missouri, New Hampshire and North Carolina and the Virgin Islands to test existing plans through the conduct of energy emergency simulations, provide reports of proceedings of meetings and assist with updates and revisions of energy emergency plans. The institute also published a special report under this program entitled "Feasibility Study for a Regional Petroleum Product Reserve in the Southeast."

Engineering and Technology Policy: The Engineering and Technology Policy Program is another venture begun by the institute in 1990-91. The program, led by Senior Fellow and Professor of Mechanical Engineering Tah-teh Yang, focuses on policy issues that arise in the design and marketing of new energy technologies to the developing world as well as issues of the political and socioeconomic impact of new technologies.

In the past year the major activity has been the preparation of a proposal to the Department of Energy to determine the feasibility of building an integrated gasification combined cycle coal-fired gas turbine electric power generation plant in the People's Republic of China. One of the major advantages of such a plant is that it is environmentally clean, despite the fact that it burns coal. Since the PRC has an abundance of coal and also is one of the world's worst polluters, there is considerable interest in this technology in the PRC as well as in the United States.

State and Local Government Policy: As part of a land-grant university, it is appropriate that the institute expend a major part of its effort on assistance to state and local government agencies as well as to citizen groups attempting to improve services provided by state and local government.

Research and public service activities in 1990-91 in this area included:

- A contract with the S.C. Water Resources Commission to develop a prototype county-wide water system, using Oconee County as a test case.
- A study sponsored by the S.C. State Development Board to determine the economic impact of state investment in infrastructure improvements, specifically four-lane highways and sewer capacity using Geographic Information System technology.
- A study to determine the most effective use of monies made available for recreational boating facilities in South Carolina, sponsored by the S.C. Wildlife and Marine Resources Department.
- An examination of exemptions to the S.C. sales and use tax, sponsored by the S.C. Tax Study Commission.
- A project sponsored by the Anderson County Planning and Development Board to determine the feasibility of and specify the procedures for incorporation of the community of Powdersville as a municipality.

Special public events under the State and Local Government Program included:

- A debate on the local option sales tax, held on September 11, 1990. This program was one of several efforts by the institute to inform voters on the subject of the local option sales tax prior to the November 1990 election.
- The second annual Harris Page Smith Memorial Lectures on Local Government in South Carolina. This series was begun by the institute in 1989 to honor the late Sen. Harris Page Smith, who was one of the leading advocates of Home Rule and a staunch defender of local government. This annual event has become recognized as the equivalent to the president's State of the Union address and the governor's State of the State message. Speakers this year were Kenneth Huckaby, president of the S.C. Association of Counties, and Mayor Thomas Drayton, president of the Municipal Association of South Carolina.
- A panel discussion on redistricting. This forum addressed the issue of redrawing legislative district lines based on the 1990 census. Speakers were: Bobby M. Bowers, director of the Division of Research and Statistical Service, S.C. Budget and Control Board; Neil Smith, chairman of Pickens County Council; Sen. Nell Smith of Pickens County; and Dr. Holley Ulbrich, Senior Fellow of the institute as moderator. The institute published two special reports and two working papers during the year under this program:
- An "Accounting Guide for South Carolina Water Districts," by Dr. E. Lewis Bryan;
- "The S.C. Local Option Sales Tax: History, Operation and Evaluation," by Dr. Holley H. Ulbrich;
- "Private and Public Choices in Public Education: An Investigation of Trustee Effects," by Robert McCormick, Cora Moore and Bruce Yandle.
- "Computer Based Techniques for School Bus Routing," by Kimberly A. Osborne, Carol A. Parker and James P. Jarvis.

Public Events and Lecture Series

In all, the institute sponsored or cosponsored more than 40 public lectures, panel discussions, conferences and seminars on a wide range of public policy issues. In addition to seizing opportunities to present programs on issues as they arose, the institute began several regularly scheduled series this year, some of which already have been mentioned above:

Third Thursday at the Thurmond: One of the more popular new program series begun this year is known as "Third Thursday at the Thurmond." On the third Thursday of each month during the academic year a program is presented at 8 p.m. in the institute auditorium. Each program brings a distinguished speaker or panel to the institute to address important public policy issues. This year "Third Thursday" programs covered the Persian Gulf crisis, the revolution in Europe, international trade, the S.C. sting (Operation Lost Trust), policy issues in education, and CNN and international news coverage. Average attendance at these programs was approximately 200 students, faculty and local citizens.

Strom Thurmond Seminar in Government and Politics: Each year the institute conducts a two-week seminar in government and politics on an issue of interest to high school and middle school social science teachers. Twenty teachers are selected on a competitive basis to participate in the seminar. The first week is held on the Clemson campus and consists of lectures and guided discussions on various aspects of the topic for that year by Clemson faculty and invited lecturers. The second week is spent in Washington, D.C., where seminar participants are afforded the opportunity to visit government and private agencies dealing with the issue at hand,

spend time on Capitol Hill in discussions with members of Congress, and hear lectures and guided discussions by policy makers and opinion leaders. In past years the seminar has focused on such topics as: Two-Party Politics in America, Religion and Politics, The Role of the Media in American Politics, and Arms Control in a Changing International Environment. This year's seminar topic was Political Economy which dealt with the impact that government regulation has on economic performance.

Forum on Constitutional Issues: The first forum on Constitutional Issues was held at the institute on September 28, 1990. The topic was "Commercial Speech Rights and the First Amendment," and the speaker was William MacLeod, former director of the Federal Trade Commission's Bureau of Consumer Protection.

Thurmond Roundtable Discussion Series: The Thurmond Roundtable Discussion Series also was begun this year. This program provides opportunities to select faculty and students to engage in discussion of topics of current interest to them. Usually one faculty member or visiting scholar will present some remarks to introduce the topic, after which the discussion will be opened to all participants. On average, approximately 25 faculty and students have attended these sessions by invitation. Topics have included economics, energy policy, Soviet foreign policy, German unification, European security, the Gulf War, public choice and environmental issues.

Publications

The institute operates an extensive publications program to disseminate the results of its research and public program activities. The institute's mailing list exceeds 15,000 and includes colleges and universities, high school libraries, research institutes, government agencies, private organizations, business corporations and interested individuals throughout the United States and numerous foreign countries. The publications program includes a lecture series, proceedings of conferences and symposia, research reports, special reports, white papers and working papers. Publications released during 1990-91 include the Harris Page Smith Memorial Lectures; four editions of "The Community Leader's Letter," a newsletter published quarterly by the Community and Economic Development Program; conference proceedings for the 1990 Southeast Climate Symposium and a seven-part teleconference on management issues for wetlands; three editions of *The Review of Regional Studies*; five special reports and four working papers.

Joint Public Policy Programs

Some programs operating under the umbrella of the Strom Thurmond Institute represent joint ventures between the institute and other organizations on campus. This usually means that other colleges or departments contribute resources to the program in the form of funding and/or personnel. Such is the case with two programs currently being operated within the institute: the Community and Economic Development Program and the Environmental Policy Program.

Community and Economic Development: In July 1989 the institute signed an agreement with the Cooperative Extension Service and the S.C. Agricultural Experiment Station to conduct the Community and Economic Development program for the benefit of rural communities throughout the state. While federal subsidies for local government programs have declined significantly, federal and state mandates regarding solid waste management, hazardous waste treatment, water quality and other issues have increased dramatically. Rural communities have felt the impact of these negative trends even more, as young people have migrated to the cities, small towns have seen businesses move to the bypasses and the outlet malls, and young professionals such as doctors, lawyers and educators seek their fortunes in larger metropolitan areas.

The importance of the Community and Economic Development program cannot be overstated. It is one of the vehicles through which Clemson will transform itself into the model land-grant university of the 21st century. By harnessing the strengths of the institute, the delivery capability of the Cooperative Extension Service and the research capacity of the Agricultural Experiment Station, Clemson will gradually broaden its focus of public service to include not just the traditional agricultural and agribusiness sector, but education, research and service throughout all academic disciplines. Through the Community and Economic Development program, Clemson will make all of the science, technology and policy research being developed on the campus available to all communities of South Carolina, but particularly to the rural communities that are in need of assistance.

Assistance rendered to local communities in 1990-91 included consultation and interpretation of economic data related to redevelopment of the downtown business area of Liberty; assisting local leaders in the Duncan/Lyman/Startex and Bluffton areas to identify options for coordination of local government activities and provision of public services; and assisting the Shiloh-Corinth Fire Department in exploring the possibility of creating a special tax district. Throughout the year the CED program provided consultation with numerous state and local organizations.

In addition to the quarterly newsletter that is mailed to 15,000 grassroots leaders throughout the state, the program also published two special reports and one working paper:

- "A Review and Synthesis of Planning Literature Pertaining to the Middle Tyger Area of Spartanburg," by Dr. Jim Hite;
- "The Orphan Roads Problem in South Carolina: Options for County Governments," by Dr. Jim Hite.
- "The Dimensions of Education: Recent Research on School Size," by Davant T. Williams.

Environmental Policy Program: One of the four major focal points of the University's strategic plan is the environment. In accordance with that plan the institute established the Environmental Policy Program in 1990-91. Much already has been done at Clemson in the areas of environmental science, environmental engineering and wildlife and environmental toxicology. To solidify that momentum the Environmental Policy Program will coordinate interdisciplinary environmental activities with a policy focus, will foster interdisciplinary policy research and ultimately intends to develop a graduate program in environmental policy.

Research being conducted under this program includes studies in solid waste management. When Hurricane Hugo struck the S.C. coast and continued inland on September 22, 1989, it inflicted greater property loss than any previous hurricane in U.S. history. The institute is examining the impact of the storm on the solid waste systems in five counties (Berkeley, Calhoun, Lee, Orangeburg and Sumter) that were in the path of the storm. It is expected that this work will lay the foundation for a statewide solid waste management plan that has been mandated by the state legislature.

Public events presented by the institute in this area included a panel discussion on "Environmental Challenges: Corporate Response," featuring William L. Carpenter, president of Sirmine Environmental; John McAlister, communications coordinator for Duke Power Company; and Linda Jennette, director of Environmental Affairs for Schlumberger North American.

The institute also sponsored lectures by Dr. Jay Hair, president of the National Wildlife Federation, and Dr. Kenneth E. Boulding, Distinguished Professor of Economics, Emeritus, at the University of Colorado.

Visiting International Scholars Program

The institute offers a Visiting International Scholars Program whereby distinguished foreign scholars are brought to the institute for a semester to conduct re-

search. While they are on campus these international scholars also are afforded opportunities to share their expertise and perspectives with students through lectures, seminars and classroom instruction.

Foreign scholars from Australia, Colombia, India, Nepal and the Republic of China have contributed to this research while guests of the Strom Thurmond Institute. During 1990-91 the Visiting International Scholar was Professor Philip Maxwell, head of the School of Economics and Finance at Curtin University of Technology in Perth, Western Australia. While at the Institute, Professor Maxwell conducted research on rural economic development, conducted seminars and produced two working papers dealing with the subject of regional per capita income divergence in the United States, Canada and Australia.

Undergraduate Studies

The Undergraduate Studies Office is responsible for undergraduate academic programs and curricula, academic standards, scholarships and awards, University-wide lectures, new faculty/staff orientation, summer sessions, the Clemson Career Workshops, the Junior Scholars, the Science and Technology Entrance Program, the Calhoun College honors program, Cooperative Education, special post-graduate scholarship programs and special University ceremonial occasions.

The Clemson Career Workshops continue to be a primary recruiting program for minority high school students. The University expects 55 new freshmen recruited by this program to enroll in the fall of 1991.

The Honors Program reached an all-time high of 806 students in 1990-91. Sixty-seven students graduated with Senior Departmental Honors in December, May and August. One Clemson student received a Fulbright Scholarship for foreign-country study in 1991, bringing the number to 29 in the past 10 years.

The Science and Technology Entrance Program, designed to aid marginal students in agriculture, forestry, textiles and industrial education technology to have meaningful access to Clemson University, has enrolled its third class. Retention rates on students who entered in this program are equal to those of regular entrants.

Cooperative Education continues to be a leader in our region. More than 625 students participated this year in more than 850 successful work assignments in industry, commerce and government. The Junior Scholars and Summer Science and Engineering programs bring academically talented students between the ninth and twelfth grades for summer enrichment programs on campus. Now in its seventh year this program enrolled 466 students in summer 1991. The 1991 summer sessions generated a record number of more than 42,000 credit hours.

DIVISION OF ADMINISTRATION AND SECRETARY OF THE BOARD OF TRUSTEES

The Division of Administration was created August 1, 1985, in conjunction with the Secretary of the Board of Trustees. The fundamental responsibility of the Administrative Division is to formulate, monitor and coordinate fiscal matters for the Office of the President as well as other areas of University administration. The vice president for administration assists the president in discharging his general administrative and executive functions and represents the president during his absence. The secretary of the board reports directly to the Board of Trustees. He records all proceedings of the board and its committee meetings, is the custodian of the University seal and all records of the board, and performs other duties as may be assigned by the Board of Trustees.

The vice president for administration supervises the director of public safety, who oversees the Fire and Police Departments; the assistant vice president for

human resources, who is responsible for the Center for the Study of the Black Experience; and the Department of Parking and Vehicle Registration, which is an auxiliary department. The University municipal judge relies on this vice president for administrative and logistical support.

The internal auditor is under the cognizance of the secretary of the Board of Trustees, who, in turn, is responsible to the Board of Trustees.

A report on each unit of the division follows.

Fire Department — Emergency Medical Service

During 1990-91 the Fire Department responded to 357 fire alarms compared with 412 the previous fiscal year; 40 percent of the fire alarms were off-campus alarms. A total of 446 emergency medical alarms were answered. This is the first fiscal year that emergency medical alarms have outnumbered fire-related alarms.

Hazardous materials incidents account for 11 percent of the total call volume.

On-campus fire property damages for this reporting period totaled \$55,300. Property damage in the city of Clemson was \$72,870. Property in excess of \$2 million was saved by direct fire department intervention during this period.

No civilians were injured by fire related alarms during the fiscal year. Two fire fighters sustained loss-time injuries during non-fire suppression related activities. There were no fire-related deaths.

Significant improvements in the CUFD-EMS' fire prevention and code compliance program were implemented, including plans review of campus construction projects and a positive working relationship with the division of the State Fire Marshal and the State Engineers office.

A second fire inspector was added to the department, which permitted 175 building inspections to be conducted during the fiscal year.

In August 1990, a five-year extension of the fire services contract with the city of Clemson was signed. The agreement stipulates a matching purchase by CHE and the city for a new fire truck, escalating cash payments to the University to defray operating expenses, and a cash payment directly to the CUFD-EMS for three years beginning FY 92-93 for the upgrading of equipment.

Excluding fringe benefits (not under control of the Fire Department), the department operated within its budget with a .98 percent surplus. A user fee was initiated for ambulance service which provided the margin of surplus.

Center for the Study of the Black Experience in Higher Education

The mission of the center is to increase participation of African Americans in higher education in South Carolina and the nation. In carrying out its mission, the center engages in four types of activities: (1) initiating and supporting research, (2) disseminating information, (3) developing and organizing demonstration projects and (4) evaluating projects. During 1990-91 significant accomplishments of the center include the following:

- The center's director and research associates (Clemson faculty) made several presentations at professional conferences and published in scholarly journals.
- Two research projects designed to increase the number of African-American children in college tracks were initiated in public schools.
- A major research project, developed in collaboration with a consortium composed of science departments from state universities and designed to increase the success participation of minorities in science careers, was submitted for funding.

- A longitudinal study, designed to investigate predictors of success for African-American college students, was initiated.
- The center solicited and received 30 research proposals from institutions throughout the state. Twelve of the proposals were funded by the center.
- A statewide teleconference was produced in collaboration with SC-ETV and 4-H.
- Four editions of *Challenge*, the center's newsletter, were circulated to more than a thousand individuals and institutions in the state and nation.
- Twenty proposals were submitted to governmental agencies, foundations and corporations.

Human Resources

The Office of Human Resources coordinates and directs the University's affirmative action and desegregation plan efforts. The department is actively involved in recruiting black faculty, staff and graduate students, mediating pre-grievances based on alleged illegal discrimination, conducting an educational and counseling program for sexual harassment, being responsible for state and federal statistical reporting, and developing projects to meet the objectives of equal opportunity and desegregation.

For academic year 1990-91, the University had 34 blacks with academic status, including four administrators. This represents a decrease of one black administrator but an increase of three non-administrative faculty. Black non-academic administrative staff increased by nine. While black graduate students decreased from 170 to 142 in 1990, the number was higher than in any other year for the past 10 years.

Internal Auditing

The staff of the Internal Auditing Division consists of eight members: an associate vice president, an audits manager, an EDP audits manager, three staff auditors, a business associate and a half-time word processing operator. The associate vice president reports administratively to the secretary of the board of trustees.

The division provides an ongoing, independent audit function for the University as a service to management. Audit parameters include financial, compliance and operational review, as well as special requests.

Municipal Judge

The staff of the University's Municipal Court consists of two judges, one full-time judge who serves as the department head, and one part-time judge who serves in the absence of the chief judge and on weekends and special occasions. Also, the staff includes a clerk of court and one student secretary. Formerly known as the University recorder (recorder's courts were abolished in 1980 by act of the General Assembly), the judge for the municipality of Clemson University hears appeals and renders decisions on all campus parking violations brought before the court, tries all persons charged with violating any ordinance passed by the Board of Trustees and any state laws that fall within the jurisdiction of the municipal judge (any crime or traffic violation for which the maximum penalty that can be imposed does not exceed \$298 or 30 days in jail). The municipal judge also issues bench warrants, search warrants and arrest warrants for incidents arising on campus.

Parking and Vehicle Registration

The Department of Parking and Vehicle Registration is responsible for managing the parking program for the University. This responsibility includes maintaining parking spaces and lots, planning and implementing construction of new parking

lots, vehicle registration and maintenance of parking violation records. For 1990-91, the department issued 19,519 decals and deposited \$305,005 for the sale of decals. NOTE: Vehicle registration for one vehicle was increased from \$12 to \$18 and for second and subsequent vehicles from \$2 to \$5. For the same period, 44,365 parking citations were issued by the University Police Department, generating \$330,558 in revenue.

The shuttle bus operation was continued during 1990-91. Three additional new 21-passenger buses became operational for a total of 10 buses. Almost 618,000 passengers rode the buses for a total cost of \$185,378.19. The average ridership was 3,430 per day and cost per passenger was 30.5 cents.

Police Department

During 1990-91 the Police Department responded to 10,175 calls for service. The 11 percent increase in the number of calls follows last year's 51 percent increase over the 1988-89 period. Police efforts during the year resulted in 316 arrests (a 15 percent increase) with \$24,621 in fines resulting from convictions. Crime rate statistics reported in SLED's *Crime in South Carolina 1990* indicated a decrease in crimes reported at Clemson University during 1990. Reported violent crimes were down by 39 percent and non-violent crimes were down by 13 percent. The decrease is especially significant considering that reported crime in Pickens County for the period increased by 41 percent and 5 percent for violent and non-violent crimes, respectively. The 1990 change in the alcohol policy (to prohibit kegs on campus) is believed to be a significant factor in the decrease in crime reported on campus. Since the policy was modified to allow kegs on campus for the fall of 1991, the department plans to compare alcohol related incidents in the coming year to develop comparative statistics between "keg" and "no keg" years. In addition to normal activities, the department provided services for 171 special events. Wayne Wardlaw, director of public safety, retired at the end of the year after providing six years of service to the University. John McKenzie, assistant director, is currently serving as acting director pending filling of the vacancy.

Investigative Division

The Investigative Division assembles facts and evidence to document a reported incident, identify offenders and assist in the administration of justice. This division also performs background investigations, coordinates the protection for VIPs to campus when requested, and helps present public safety programs. Captain Mac McCrary, the division commander, was elected to serve as president of the S.C. Campus Law Enforcement Officers Association. Accomplishments of the division include:

- The absence of gang members loitering about campus at the start of the 1991-92 school year signals the apparent success of earlier efforts to identify and remove non-student gang members from campus.
- Investigators participated in several speaking engagements where they presented information to students on topics of current interest including drug abuse and fake identification cards.
- Provided in-service training to investigators in various topics. One of the investigators completed training required for certification by the S.C. Criminal Justice Academy during the year.
- Provided protection for four dignitaries during their visits to campus.
- Supervised the activities of Pre-trial Intervention participants who provided 514 hours of public service to various University departments.
- The division operated with an average case load of 108 active cases per investigator and included several time-consuming investigations into white-collar type criminal activity. Follow-up investigations resulted in 49 arrest warrants being obtained for criminal prosecution.

Uniformed Patrol Division

Uniformed patrol officers move about campus to deter and detect criminal activity, preserve order, direct traffic, investigate accidents and enforce state laws and University parking regulations. Additional services provided by the division include monitoring intrusion and fire alarms, providing dispatch service for fire and EMS and evening dispatch service for FM&O and campus shuttle buses, and maintaining traffic signs and street markings. Significant accomplishments of the division include:

- The traffic safety program provided defensive driving instruction to 250 campus citizens. Enforcement of traffic laws included the issuance of 854 traffic citations which resulted in fines totaling \$41,965.
- Parking enforcement efforts resulted in 44,365 citations issued from July through May. The office's effectiveness continues to be hampered by the lack of parking enforcement vehicles, as mentioned in last year's report.
- Preventive patrol efforts suffered as the result of a cutback in funding for contract security officers. During the year 2,333 escorts were provided to campus citizens.
- The variety of training subjects and hours of in-service training required by the S.C. Criminal Justice Academy continued to increase to maintain certification for sworn personnel. During the year 3,052 hours of training were provided to police personnel.

Two recent replacements to the marked patrol vehicle fleet consisted of cars with down-sized engines. There are concerns for officer safety and traffic enforcement ability due to the change.

Administrative Division

The Administrative Division is responsible for developing and presenting public awareness programs, the supervision of student police officers and working with victims of crime by providing services and information to help them cope with the criminal justice system and with the stress caused by victimization. Additional responsibilities of the division involve criminal evidence management and inventory of departmental keys and equipment. Significant accomplishments of the division include:

- Updated and provided safety-related programs to new students, international students and employees through orientation sessions.
- Established objectives and identified materials and supplies needed to comply with the Federal Hazardous Substances Information Act.
- Initiated and presented several new programs/publications on campus safety and crime prevention to students residing off campus in addition to those for on-campus students.
- Participated in special programs during Victim Awareness Week and Rape Awareness Week and provided training to participants of the University Rape Crisis Volunteers and Peer Educators programs.
- Assisted in providing community service programs for the Residential Life Judicial Review Program and for the Student Life Judicial Program.
- Provided victim/witness services to 738 campus citizens.
- Received an award of \$7,000 from the President's Innovation Fund to organize a Social Awareness Committee and to develop and publish *Rape, Campus Life and You*.
- Assisted in the development and implementation of the Foothills Crisis Response Team which supports victims and witnesses in the Pickens/Oconee County area — an area housing a large proportion of commuting students.

- Student police officers assisted the department by providing 4,057 hours during special events, 1,476 hours painting street marking, 3,072 hours of special surveillance and 2,254 hours for athletic events, traffic direction, parking enforcement, dispatch and VIP transport services.

Lack of sufficient funding brought student police and contract security operations (except for events where expenses were recoverable) to a halt at the end of the third fiscal quarter. The increased calls for service, increased training requirements, addition of the 600-bed Lightsey Bridge Apartment Complex and funding cutbacks will tax the ability of the department to provide quality service at present staffing levels. Equipment needs from last year, including vehicles, radio communications and computer software have not been provided. Allocation of existing resources in a manner sufficient to continue providing quality safety and security services for campus citizens will be a challenge for the department administration in the coming year.

BUSINESS AND FINANCE

Business and Finance is responsible for determining the broad policies of institutional functions relating to administration, business and finance, and for managing specific administrative, fiscal and auxiliary functions. These departments comprise more than 1,000 full-time, part-time and contract employees responsible for managing financial resources in excess of \$72 million.

The vice president for business and finance has targeted five categories for a division-wide emphasis on improvement. These categories, Governmental Relations and Communications, Quality and Leadership, Strategic Planning, Environment, and Accountability, and the accomplishments of Business and Finance departments are discussed in the sections which follow.

Governmental Relations and Communications

Working in cooperation with other members of the campus community, Business and Finance helped enhance Clemson's relationships with a variety of Clemson constituencies. Members of the Business and Finance organization increased efforts to establish and renew contact with state agencies including the Joint Bond Review Committee, the Commission on Higher Education and the Division of General Services. Business and Finance staff contributed to the publication of the *President's Report* and the *Research Report* for the Office of University Research.

Efforts to improve communications within the University continued with the *Management Letter*, containing information on salary and compensation issues, budgets, formula funding and Business and Finance accomplishments, and *CUnite*, a newsletter periodically updating progress on the University's strategic planning, self-study for accreditation and assessment of institutional effectiveness processes. The Office of Institutional Research produced the University's *Fact Book* and the Budget Office published a budget analysis fact book for campus-wide distribution. Business and Finance also published the newsletter, *Kudos*, to identify and thank personnel from across campus who contributed to Business and Finance improvement efforts.

Revisions to the *Business and Finance Fiscal Policies and Procedures Manual* and the brand new *Budgets and Financial Planning Manual* were distributed to the campus. Updates to *Travel Policy — An Employee's Travel Guide and Departmental Business Management — An Executive Summary for Department Heads* were released to provide easy access to University policies. A newsletter, *Clemson 2000*, was distributed to inform the campus about permanent improvement projects in the planning, design and construction phases.

Special meetings have been held with academic department heads and individual

faculty to encourage discussions on a broad range of budget, research and personnel issues.

Quality and Leadership

Business and Finance initiated an ambitious program of self-evaluation and non-traditional thinking to change the organization's culture, increase the focus on quality issues and develop methods of controlling and reducing administrative costs. The effort is designed to prepare Business and Finance for the new challenges and the dramatic increase in demands which will be made on the organization in the next decade.

The accounting firm of Deloitte and Touche was commissioned to conduct an organization review of Business and Finance administrative functions. The objective was to streamline process and functionally structure the organization to achieve maximum efficiency and effectiveness. The review, completed and implemented during 1990-91, resulted in significant cost savings and national recognition in the form of a National Association of College and University Business Officers (NACUBO) cost reduction incentive award.

Business and Finance personnel participated in external programs on quality issues with industry leaders including Milliken, Westinghouse and Xerox. Business and Finance also serves on the University-wide Ad Hoc Leadership Development Council (LDC) which integrates quality and strategic planning activities.

Task Forces were formed to study and recommend improvements in four key business processes: Purchasing/Payables, Personnel, Work Orders and Travel. The Task Forces were asked to document existing processes and recommend improvements to streamline and improve each area.

Strategic Planning

The strategic plan for Business and Finance was revised and the Campus Master Plan was updated in accordance with the campus strategic plan. Improvements in the integration of the University strategic plan with operational, facilities and financial planning have been made. An innovation fund continued to fund University Strategic Plan priorities. In addition to monitoring the implementation of strategic plan priorities, the Planning Office continued to publish *CUnite* to communicate progress in planning, self-study and assessment. The office worked with the Environmental Scanning Committee to collect data and provide information to the Strategic Planning Committee on faculty and staff demographic patterns and faculty retirement projections. Nationally known consultants were brought in to speak to faculty, staff, students and administrators about planning and total quality management. The office developed a reference library for the President's Leadership Development Council and coordinated various "guided experiment" group efforts as part of the University planning process.

Environment

Environmental issues are a major part of Clemson's future, both academically and from the standpoint of institutional operations. Facilities Management and Planning has worked with the Environmental Committee to support recycling efforts of paper and aluminum can products. Facilities personnel have consulted with the Environmental Committee and faculty on the environmental impact and research potential of the possible power plant expansion. University officials also have worked with local officials on developing additional landfill space. The campus energy officer expanded conservation efforts to include new initiatives approved by the president.

Accountability

Business and Finance has instituted numerous process, organization and policy changes to ensure greater accountability. The vice president formed the Accounting and Business Standards Review Advisory Committee (ABSRAC) to review all in-

ternal audit reports and recommend policy and procedure changes for tighter internal controls. ABSRAC reviews resulted in changes in procedures for plant fund transfers, investment income allocation, line-of-credit cash draws for auxiliary units, and construction project close-outs. Other significant improvements include tighter control and recording of inventories, more accurate accounting for lease expenditures, posted endowment budgets, and a revised theft policy requiring a police report prior to writing off fixed assets.

Budgets and Financial Planning

The University's beginning budget for current operations for fiscal year 1990-91 exceeded \$283 million, which reflected a 5.6 percent overall increase from the prior year. However, the percent of the CHE formula for Educational and General (E&G) operations in higher educational institutions in South Carolina continued a downward trend, dropping from 92.7 percent in fiscal year 1989-90 to 87.7 percent in fiscal year 1990-91. During the fiscal year Clemson's state appropriations were reduced by \$3.5 million — \$2.5 million in E&G funds and \$1 million in Public Service Activities (PSA) funds — resulting in only a \$4.2 million increase in E&G appropriations and a \$0.2 million increase in PSA appropriations.

Clemson began fiscal year 1991-92 with a current operations budget of more than \$304 million, a 7.5 percent increase over fiscal year 1990-91. This increase resulted from additional revenues generated by student fee increases, increased levels of auxiliary operations, and restricted funding received for sponsored programs other restricted purposes. Fiscal Year 1991-92 saw an even further erosion in the percent of CHE formula for E&G operations in higher education institutions in South Carolina; in fact, state funds for fiscal year 1991-92 were not allocated by CHE using the formula. As a result, initially, Clemson received only 73.6 percent of formula, while higher education institutions received on average 77.3 percent of the formula. When the 3 percent reduction/sequester mandate is taken into consideration, the percent of formula is further reduced. Effectively, state appropriations have been reduced at least \$7.1 million in E&G funds and \$3.2 million in PSA funds, for a total of \$10.3 million. These reductions resulted from the initial 3.3 percent reduction, absorbing the annualization of salaries/fringe benefits, absorbing increases in fringe benefits, and the 3 percent reduction/sequester.

In absorbing budget reductions, the University has assured the quality of academic and research programs is not affected by distributing the greater part of the reductions to administrative areas.

In June 1991 Budgets and Financial Planning provided the campus with a policies and procedures manual that embodied financial planning, budgeting and costing.

Budget Office

The Budget Office has conducted campus-wide training explaining the CHE formula and the block funding model. Throughout the year meetings and written correspondence have been provided to the campus to assure open communication on budgetary issues.

To maximize the effectiveness and efficiency of the University's budget activities, the block funding model has been under continual refinement by an ad hoc committee established by the provost, with the additional charge to communicate the model to the campus.

New permanent FTE positions (163) authorized by the state were established with the state Office of Human Resources Management. Funding source updates were processed with Human Resources Management to reflect 1991 funding for the 4,663.83 FTE positions authorized to the University. The Budget Office continued to update the FTE position database which contains historical data on positions and funding from 1986 forward.

Annual budget requests were prepared and submitted to the state, and University operating budgets were prepared reflecting the allocation of resources approved by the administration and Board of Trustees.

A Budget Analysis Report was released in July 1990 and updated in January 1991 to translate Clemson's budget into a format understandable to individuals unfamiliar with the accounting and budgetary practices of a university.

The advisory services of the Budget Office were linked directly to each budget center through the assignment of Budget Office personnel as liaisons to specific budget centers.

The Budget Office continued the evolution of its "shadow" formula database to that used by CHE to determine the economic impact of formula revisions developed by Clemson.

Managerial Accounting

The Managerial Accounting Office expanded the review of Business and Finance billing rates to include rates for other campus units. After approval the billing rates will be published in booklet form and distributed to the campus.

The indirect cost proposal was prepared. The proposal included an analysis of University costs as well as a space-utilization study.

The Managerial Accounting Office began a systematic review or "scrubbing" of the indirect cost process to insure the rates include only costs allowable by federal guidelines.

Guidelines were developed for the establishment and administration of special university organizations, such as centers, institutes, associations, alliances and programs.

Financial Planning

The University strengthened its financial future by initiating a financial planning process which will provide three years of historical and two years of projected data and analysis.

Peer institutions were contacted to obtain copies of financial planning reports.

A standard memorandum of agreement was developed for use in documenting the funding of facility costs.

Institutional Effectiveness and Sponsored Programs

During fiscal year 1990-91 several departments within Information Management were merged with Sponsored Programs to form Institutional Effectiveness and Sponsored Programs. This newly structured organization is concerned with the development, coordination and maintenance of Business and Finance programs in the areas of data processing services, networking, information systems, management services, planning, assessment, institutional research and sponsored programs. Major efforts throughout the year have been to support the institutional self-study and accreditation activities and the financial and human resources software systems procurement activities.

Administrative Data Processing

Decentralization of this activity was completed. Personnel assigned to Administrative Data Processing either retired or were transferred to other departments within Business and Finance.

Sponsored Programs

The Office of Sponsored Programs provides administrative support for the development, submittal and approval of contracts, grants and cooperative agreements in a manner that ensures compliance with prudent fiscal policies, sound management practices and regulatory requirements. During fiscal year 1990-91 sponsored program awards exceeded \$33 million, a substantial increase over the previous

year. Expenditures in excess of \$26 million were incurred in activity supporting more than 900 sponsored programs.

One of the more significant sponsored program activities is the five-year cooperative research and educational agreement with the Greenville Hospital System. This agreement was formulated to provide the Hospital System with the latest and most advanced educational and research programs in biomedicine. The University is expected to benefit primarily from enhancements to its biologically oriented programs. Areas of cooperative concentration include health care delivery systems, bone and mineral metabolism, and reproductive physiology.

Institutional Research

The Office of Institutional Research continued to support the Southern Association of College and Schools (SACS) self-study committees by providing additional data, graphic support for the final document, and by coordinating the visit of the SACS accreditation team.

The office continues in its role of assisting in the preparation of numerous reports and in reviewing others for content and accuracy. These reports contain data for units and programs within the University and for outside groups, such as The Southern University Group (SUG), a data-exchange group of 27 institutions located in the South; more than 30 peer institutions across the nation; and the Integrated Post-secondary Education Data System (IPEDS) reports for CHE and the U.S. Department of Education.

In conjunction with the Assessment Office, OIR has been assisting in formatting a wide variety of surveys and in compiling and interpreting the results.

Institutional Research completed its third annual *Clemson University Fact Book* and updated the electronic fact book available online. Summaries of faculty salaries, library salaries, graduate stipends, retention statistics, administrative salaries, enrollment data and faculty workloads also were prepared. The office assumed the duty of preparing the SUG Faculty Workload Analysis.

Members of OIR have been very active participating in conferences throughout the country with a total of eight presentations being made at the Association of Institutional Research, the Southern Association of Institutional Research, the S.C. Association of Institutional Research and S.C. Higher Education Assessment network conferences. Two graduate assistants within the office presented a paper at the S.C. Association of Institutional Research. The head of Institutional Research is the president of the S.C. Association of Institutional Research for 1990-91 and has been named to CHE's Advisory Committee on Institutional Research.

Management Services

Management Services coordinated and participated in the work of task forces to improve policies and procedures in four areas: Purchasing/Payables, Personnel, Work Orders and Travel. The task forces are composed of personnel from across the University organization. They are charged with documenting existing processes and recommending policy and procedural improvements. Management Services also began updating the "Organization Analyst" software used in the Deloitte and Touche organization review.

Business Information Systems

Business Information Systems(BIS) directs and supports all computing activities within the Division of Business and Finance. In the past year BIS completed the decentralization of Administrative Data Processing which served as a centralized data-entry department. BIS has established a staff resource center to train Business and Finance personnel in the effective use of microcomputer and mainframe systems. Business Information Systems also uses this training center to install and test new hardware and software prior to its release to users. BIS works with Business and Finance personnel, faculty and the Division of Computing and Information Technology to provide a campus-wide approach to University information systems.

Office of Assessment

In 1990-91 the Office of Assessment concentrated efforts on supporting the University Assessment Committee, providing assistance in responding to the SACS self-study on Criteria 3, Institutional Effectiveness, updating the assessment plans for the CHE, and reporting to the CHE on the various components having due dates of this year.

The Office of Assessment continues to support the University Assessment Committee and to facilitate assessment activities across campus. The office also has been assisting the Strategic Planning Committee by offering advice and assistance in developing measurable objectives based on the Strategic Planning Committee's proposed goals. One meeting has been held jointly with the Strategic Planning Committee and more joint meetings are planned. Additional support has been extended by assisting with the response to the Institutional Effectiveness area of the University's self-study for reaccreditation by SACS in the areas of both planning and assessment.

In January an updated assessment plan was submitted to the CHE, outlining how the University will respond to the reporting requirements on the 18 components required by the commission. In June reports were submitted for eight of those components, two of which were reported a year earlier than required by the commission. The result was a two-volume report. The first volume contained the action plans for the eight components and the second volume contained Appendix A-E, supporting documentation. Much of the information contained in the report was the result of an alumni survey and a general education examination, both of which were administered through this office, with the assistance of the Office of Institutional Research. The findings from both sources were given wide dissemination across campus through reports and presentations to various groups and committees who could make use of the information.

In the spring the office applied for and received a grant from University innovation funds. The grant is being used to sponsor two one-day workshops for department heads. The workshop will be conducted by Dr. James O. Nichols, a recognized expert in assessment and a frequent member of SACS visiting teams for Criteria 3, Institutional Effectiveness. The workshops will focus on meeting all the reporting requirements from both the state and the regional accrediting body in the most effective and efficient manner.

The Office of Assessment has made an effort to remain involved and visible on the regional and national level regarding issues of institutional effectiveness. An article written by the director of assessment was published in the spring issue of the journal, *Research in Higher Education*. Also, the director has been asked to be a reviewer for papers submitted to the Association for Institutional Research (AIR) for Track 2, Institutional Effectiveness. AIR is a nationally recognized forum for higher education professionals. In addition, the director and the chair of the University Assessment Committee have submitted, and had accepted, a joint paper presentation for the Southern Association for Institutional Research. The paper will be presented at the annual meeting in Oklahoma City.

Business and Financial Affairs

This program area provides the campus with goods and services through Accounting Services, Business Affairs, Sponsored Programs Accounting and Compliance, and Business Services. Emphasis has continued during the year to reduce paper flows, evaluate processes, evaluate and recommend policies and procedures, and improve reporting mechanisms and internal controls. Revisions were completed for the *Clemson University Policies and Procedures Manual*, the guide for department heads, and the travel policies guide. A new manual, the *Clemson University Sponsored Programs Policies and Procedures Manual*, was begun and will be ready for campus-wide distribution during fall semester 1991. The Deloitte

and Touche organizational review was completed, and a reorganization was effected in September 1990 for Business and Finance which consolidated all the auxiliary functions within Business and Finance under Business Services, a/k/a Tiger, Inc. (Note: Tiger, Inc. is an expression used by the vice president for business and finance to convey the spirit of entrepreneurship displayed by Business Services. Currently, no Business Services department is incorporated.) Emphasis has been placed on implementing uniform operating procedures for the Business Services area and expanding services for the campus community.

Business Affairs

Despite a reduction in staff the Bursar's area streamlined some processes without reducing services. Coordination with auxiliaries, bank personnel and security provided direct bank deposits. Deposits are made quicker for maximum utilization of funds. A significant reduction in the number of refund checks written for less than \$50 was managed by placing these funds directly into Tiger Stripe Accounts. A letter notifying graduates of outstanding debts is now mailed to help reduce potential graduation problems. A database of donor aid suppliers has been created to generate invoices each semester. A tiger paw charge card form is now a part of the advance bill instructions to reduce postage. In conjunction with Student Affairs, registration turn-in stations were combined with cashier locations as a convenience to students. The Palmetto Ballroom now is utilized during registration to provide better service to students on financial aid.

The Non-Student Receivables area made a significant breakthrough in working with Federal Express to identify departments on freight bills. Considerable time savings has resulted with this change. A daily transmittal was created for invoices which reduced the number of receipts written by the Bursar's staff. A series of collection letters now is automated to inform debtors of non-payment consequences. The State Refund Tax Debt reduction was utilized for the first time for debts other than delinquent loans.

Disbursement checks were designed to minimize Accounts Payable staff time in mailing vendor checks. Procedures and redesigning of forms were restructured for streamlining. Recycled paper was used for backing sheets in lieu of purchasing paper. The Bursar's staff assisted in mailing vendor checks during year-end closing to provide assistance to the Accounts Payable audit staff. Several training sessions were held on disbursements.

Sponsored Programs Accounting and Compliance

The Office of Sponsored Programs Accounting and Compliance, formerly a component of the Office of Sponsored Programs Administration, was established as part of the Business and Finance reorganization of September 1990. The mission of Sponsored Programs Accounting and Compliance is to advise appropriate University officials on matters relating to federal and state laws, and regulations and policies pertaining to contracts, grants, cooperative agreements or other types of sponsored program agreements. In addition the Sponsored Programs Accounting and Compliance administrative management provides accounting and reporting services for all sponsored projects.

In fiscal year 1990-91 sponsored program awards reached an all-time high of \$33,599,166; expenditures were in excess of \$30 million.

In September 1990 the Office of Sponsored Programs Accounting and Compliance was assigned an additional function. The federal government has mandated recipients of federal funds have compliance programs certifying the enforcement of all applicable federal laws. Sponsored Programs Accounting and Compliance has been charged with this responsibility. The laws are numerous ranging from Equal Opportunity, Drug Free Workplace and Procurement Integrity, to Animal Welfare, etc. Sponsored Programs Accounting and Compliance will be responsible for monitoring all compliance activities campus wide. Through efficient management of

compliance requirements by the appropriate departments, Clemson will have a viable compliance program at minimal additional costs.

Business Services

Agricultural Product Sales

Agricultural Product Sales became a new department under Business Services in January 1991. The department is designed to provide the campus with a retail outlet and manufacturing facility offering a variety of Clemson agriculture food products, but specializing in dairy products. It serves the University community, as well as the Clemson community, with the finest quality dairy and food products.

The goal of Agricultural Product Sales is to improve efficiency and services to better serve and satisfy our customers. The center is in the first stages of planning for a renovation that will make the entire operation more efficient, as well as improving the appearance of the facility. A pre-pricing scheme for some of the products sold also is being investigated which will shorten waiting time for our customers.

Agricultural Products Sales Center: New services have been a vital part of the growth of the Agricultural Products Sales Center. Included in these new services are extended sales hours. The center now is open from 9 a.m. to 9 p.m., Monday through Saturday, and 2 p.m. to 5:30 p.m. on Sundays. The introduction of student discount coupons has been very successful in bringing in new and later-in-the-day business. Also meats from the Clemson Meats Lab are for sale.

Dairy Processing Plant: The Dairy Processing Plant also offers new products. A full line of fluid dairy products (skim milk, lowfat milk, whole milk, chocolate milk and buttermilk) are offered in three different sizes: gallon, half gallon and quarts. These products are sold to customers through the Agricultural Products Sales Center and East Campus Convenience Store. The processing plant also is now making iced tea for Harcombe and Schilleter Dining Halls.

Cheese Room: The Cheese Room began taking phone orders during the summer for Clemson Blue Cheese to be shipped during the 1991 Christmas season. This gives many customers the luxury of giving a delicious "Clemson" gift for Christmas.

University Bookstore

The University Bookstore is a self-sustained, full-service campus bookstore dedicated to providing desired goods and professional services to faculty, staff, students and visitors. Our goal is to improve and continually expand our product selection and customer service in response to campus needs.

Projects completed in 1990-91 include:

- An up-to-date inventory control system with point-of-sale, textbook, general book and accounting modules has been purchased and installed in the Bookstore.
- The Arts and Engineering Department has been reorganized to provide ease of access as well as an increase in variety of merchandise utilizing plan-o-grams developed by National College Supply Inc.
- The Textbook Department has been renovated. A new floor plan allows for expansion in the area of trade and general books. Increased shelf space allows higher stock levels to be maintained on the sales floor.
- Ingram's "Books in Print Plus" software package has been installed, allowing customers to perform rapid searches through a database containing information on more than one million titles currently in print.

- A balloon bouquet service now is offered at the Bookstore with on-campus delivery available.
- Several new products and clothing lines have been added, and sample product programs were initiated to increase student awareness of these new products. A continuous advertising program in *The Tiger* promoted the Bookstore, as well as informational articles sent to *The Clemson Weekly*.

Business Services Management

Business Services Accounting: Business Services Accounting began its first year of service by combining staff from several departments to centralize the accounting functions for the Business Services units. This centralization has resulted in increased efficiency and productivity by eliminating duplication of effort among departments. It also has allowed each accounting technician to specialize in one of three areas: accounts payable, accounts receivable and revenue, and payroll/personnel functions.

Card Access Services: The Card Access System was implemented in July 1990. When students and faculty returned to campus for fall semester 1990, the new Card Access System was available for use in the following areas: all dining hall facilities for board plans; cash purchases deducted from the prepaid Tiger Stripe Account at the canteen; East Campus Convenience Store; University Bookstore; University Laundry and Dry Cleaning; Telecommunications; University Union gameroom; Union Copy Center; Lindsey's (faculty/staff dining room); for distribution of student football and basketball tickets; admission to Fike Recreation Center; library privileges; Redfern Health Center privileges; and student voting privileges.

Additional usage areas implemented in the 1991 spring semester included: University Postal Services; soft drink and snack vending machines; and door access for several academic and administrative areas.

Expanded system use within the next three years includes the following areas: University inter-departmental charges; copy machines; laundromats; door access; and faculty/staff charge plans.

The challenge for the Card Access System is that its opportunities for success will be measured in terms of greater service and convenience for the campus community and greater profitability for the University measured primarily in terms of retaining dollars on campus that previously were spent off campus.

Due to the implementation of the new card system it was necessary to issue 27,000 new "one card does it all" identification cards.

Business Support Services

Dining Services — Harcombe, Schilletter, Clemson House: These Dining Services operations provide service for food needs primarily to meal plan students and cash customers. These operations are self-supporting and contribute to the overall campus life experience of students.

Participation in the University's dining services increased by approximately 200 people. More than 9,500 students participated during the fall semester.

Projects completed in 1990-91 include:

- Dining options added during the fall include one new meal plan and a Treat Yourself Right (TYR) Program which includes healthy, low-calorie meals. A potato bar and bread bar were added to the Harcombe and Schilletter dining facilities; a pasta bar was added to Harcombe; and a gourmet bar was added to Lindsey's.
- With greater emphasis on healthy diets, a full-time dietitian was added to the staff. The dietitian is available for consultation with students who have health or diet concerns. The dietitian also advises the Athletic Department regarding diets for athletes.
- The Clemson House dining facility ventilation system as well as the Har-

combe roof, refrigeration and ventilation systems, and the cooling tower, were renovated to comply with state fire code.

- A new mobile food operation was put into service for the East Campus area and will serve salads and hot food items such as hamburgers, pizza and hot dogs.
- A new five-year contract for dining services was negotiated and awarded during the year.

Canteen: The canteen is designed to provide fast-food service to students, faculty and staff. The canteen is an alternative to the dining halls. Cash and the Tiger Stripe Account are accepted. The canteen also is a gathering place for student socializing, late-night food and pizza delivery.

Campus and state approval was granted for building a new canteen to be located between Riggs Hall and Fernow Street. An architect and a consulting firm were hired to complete architectural and design drawings. Construction will start in the fall of 1991.

East Campus Convenience Store: The East Campus Convenience Store offers a limited "brand" variety but a wide "item" variety of packaged foods and fresh vegetables for those students and staff who prepare meals in their own kitchens. This is a self-supporting operation dedicated to convenience and service.

Projects completed in 1990-91 include:

- Renovated the East Campus Convenience Store to make the entrance more attractive and convenient. A food counter was added to provide customers with a selection of quick foods such as hot dogs, popcorn, nachos, soups, chili and Icees. The service counter was expanded, and neon lighting was installed. In addition the access area was paved, outside lights were installed and landscaping was done to make the outside of the building more attractive.
- Retained Ken White Associates to compile a Campus Retail Site Location Strategy Plan. This plan proposed a new "canteen" type cash and declining balance plan operation on the East Campus and multiple locations for new super convenience store operations on both East and West Campus.
- Received approval from the Campus Facilities Committee to proceed with the development of a new West Campus Super Convenience Store, which will include a copy center.

CATS Shop: The CATS Shop provides service primarily to the customer desiring a quick snack. It is a self-supporting operation which operates for the convenience of students, faculty, staff and University visitors.

Projects completed in 1990-91 include:

- A major renovation of the CATS Shop was completed in mid-October. The interior of the shop was attractively redecorated and new countertops and equipment were installed. The CATS Shop also was set up to accept the Tiger Stripe Account.

Vending: Vending provides conveniently located and operable beverage, snack and vended food machines loaded with desired products for purchase by the campus community.

New vending contracts were negotiated with Coca-Cola Company of Greenville and Cromer Food Services, Inc., of Anderson. The change from the previous vendors was accomplished during Christmas break. Approximately 120 drink machines, 60 snack and 10 vended food machines were installed. Sales are running 30 percent ahead of last year's sales at this time. As part of the contract Coca-Cola and

Cromer are in the process of installing debt card readers on 72 drink and snack machines at selected sites.

Central Services

Central Services became a new department under Business Services in January 1991.

Central Services is a full-service office and janitorial supply store dedicated to providing desired quality office furniture, office supplies and janitorial products including prompt delivery service to faculty and staff and Extension Services.

Renovations to the existing Central Stores warehouse began in March 1991 to provide a modern showroom capable of accommodating walk-in customers in a retail store atmosphere. The Central Stores showroom is scheduled to officially open in September 1991. This facility will provide a centralized, single source for needed office and janitorial supplies at the lowest possible price, in comparison to outside vendors, and improved services to the University community.

Information Support Services

University Printing Services: University Printing Services provides printing and duplication services to the University. In addition to state-of-the-art typesetting, one- and two-color printing, and high-speed photostatic duplicating, other services include document assembly, finishing, folding, inserting, labeling and bulk mailing. University Printing Services prints and duplicates more than 29 million pieces of paper annually.

Projects completed in 1990-91 include:

- A networked computer system was fully installed and is online. This system will eliminate manual computations with regard to the paper and supplies inventory system and expedite estimation of jobs and costing out individual job tickets.
- Purchased a film processor for the darkroom area. Pre-press preparation will be greatly enhanced with this piece of equipment. All processing was previously done manually.
- University Printing Services has joined the push toward recycling. All magazines and newspapers are saved and taken to a local collection area. All small pieces of trimmed paper are also saved and collected by FM&O several times each week. We also are in the process of recovering negative developing solutions that have silver content which are purchased by salvage companies. Printing inks are being replaced with vegetable-based soybean inks. Recycled paper also is available.

Copier Management Program: The University's Copier Management Program is dedicated to providing the best possible duplicating services to University departments at the most economical cost. Our goal is to continue to augment this program to encompass as many areas on campus in response to campus needs and growth.

Projects completed in 1990-91 include:

- Under the terms of a new copier blanket maintenance plan servicing Ricoh and Savin copiers, all Ricoh and Savin copiers (79) were replaced with new machines. Under this agreement, supplies (toner, developer and fuser oil) and full-service maintenance for each machine are included. The machines were professionally installed within 30 days with complete key operator training. By replacing these machines the number of service calls has been greatly reduced.

Union Copy Center: The Union Copy Center is a self-supporting duplication operation dedicated to providing top-quality high-speed photostatic duplicating to

faculty, staff and students, at the most economical cost. Our goal is to improve and expand our services continually in response to campus needs.

Projects completed in 1990-91 include:

- Successfully took over production and sale of academic class notes and lab manuals. In the past, sale of these materials was handled by the University Bookstore.
- Students may now use their Tiger Stripe Account in the Union Copy Center. A new cash register was purchased to handle this method of payment.
- An additional self-service copier was added in the Union Copy Center. This will eliminate the time students must wait in line to use these copiers.

University Laundry Services

University Laundry Services offers full-service laundry, dry cleaning, linen rental, uniform rental and coin-operated laundromats to students, faculty, staff and the University community.

Projects completed in 1990-91 include:

- Improved laundromat facilities for East Campus residents by painting, clearing drains and vents, and repairing and replacing lighting.
- Installed evaporative cooling in the Dillard Building location improving customer and employee comfort.
- Purchased 500 sets of new uniforms for custodial and maintenance employees and supervisors in Housing and Facilities Maintenance and Operations.
- In response to customer requests and in an effort to assist the University's focus on recycling, the laundry began recycling used hangers. A wooden box was designed to collect hangers and placed near the counter in the Dillard Building. Customers are invited to take hangers and return hangers they no longer need. In addition to receiving very favorable response from customers the recycling has reduced the expenses for new hangers.
- Prepared and mailed informational brochures detailing services available at the laundry. The brochures were mailed to all students, faculty and staff resulting in an increased awareness of campus laundry services.

Transportation and Communications Services

Transportation Services: Transportation Services provides safe and serviceable passenger- and cargo-carrying vehicles to University departments having transportation needs that cannot be met using their existing resources. This department also provides fuel and maintenance support for the pooled fleet, as well as for vehicles belonging to other University departments. Faculty and staff use of University-owned and charter aircraft and bus charter needs are also scheduled by this department. Transportation Services provides cost effective transportation through centralized management of resources, while furnishing individualized support of departmental transportation needs.

Projects completed in 1990-91 include:

- The motor pool fleet remained basically the same size during the past year. Continued emphasis is being placed on permanent vehicle leases in lieu of departmental ownership. Vehicles on permanent departmental lease increased from 80 in June 1990 to 96 in June 1991.
- The motor pool fleet raveled 3,088,587 miles in fiscal year 1990-91, an increase of six percent over the previous year.
- The number of vehicles available to support the student shuttle system continued to increase with the addition of three new, 21-passenger, airport-style shuttle busses in August 1990, and in November 1990, two used,

16-passenger busses previously owned and operated by the Student Government Association.

- The Transportation Services Maintenance Shop received an outstanding rating during the state certification inspection. Only six shops of 89 inspected in the state last year received the outstanding rating. Transportation Services personnel continue to work with the State Division of Motor Vehicle Management and University departments to obtain state certification of maintenance shops. Seven of the nine shops now have been certified.

Telecommunications Services: The Telecommunications Services operation provides communications services to the University's students, faculty and staff. This department provides telecommunications installation, repair, system management and billing services to the campus community and coordinates the provision of telecommunications products and services by outside vendors, frequently assisting vendors in research and development efforts to improve products and services.

Projects completed in 1990-91 include:

- Telecommunications Services and Southern Bell Telephone Company installed two fiber optic carrier systems on campus. These systems employ the latest in telecommunications technology to allow transport of hundreds of telephone conversations over four strands of glass fiber that are smaller than a human hair. One of the fiber optic systems provides telephone services to the Poole Agricultural Center, the building with the most telephones on campus. The second system is providing telephone service to the newest residence facility, the Lightsey Bridge Apartments.
- An agreement was entered into with AT&T allowing for installation of their long distance facilities into the present campus system for the purpose of sending incoming calls from their network directly to the dialed number. The University should realize \$60,000 annually in shared revenues from AT&T.
- Bid specifications were written and term contracts established with vendors for procurement of most equipment and supplies regularly purchased. The lower prices secured by the term contracts should result in significant savings to the University.

University Postal Services: Postal services are provided on campus by University Postal Services. Incoming U.S. mail and on-campus mail are delivered to students via more than 7,800 boxes located in the post office lobby. Stamp and money order sales, parcels, insured, certified, registered mail and facsimile services also are provided at the lobby counter. Mail pickup and delivery service is provided to faculty and staff offices. University Postal Services processes approximately 40,000 pieces of mail and 250 parcels daily. This operation continues to develop a variety of automation initiatives designed to improve service and reduce costs.

Projects completed in 1990-91 include:

- Installation of Tiger Stripe Account card readers allowing students to purchase stamps and other postal related services on their Tiger Stripe Account.
- Operating hours were extended to 4:30 p.m. at the service counter and from noon to 5 p.m. at the package window.
- A U.S. Postal Service mail drop box was installed near Schilleter Hall.
- A fourth inter-office distribution route and express courier route were added to the existing routes allowing for delivery and pickup earlier in the mornings and afternoons.
- A postal seminar was held to provide training to departments on proper mailing and addressing procedures.

- A new computer was purchased to maintain student post office box records and to process student summer mail forwarding.

Accounting Accomplishments

Improving service to our users has been a high priority. Staff members have served on the Purchase Order/Payment, Work Order, Travel and Ethics Task Forces. Extensive efforts have been made to define, evaluate and meet the requirements of the accounting system's users. Departmental accomplishments include:

Accounting Services

Accounting Services has been actively involved in the debate and offered comments on proposed changes in accounting principles by the Financial Accounting Standards Board and the Governmental Accounting Standards Board. Reorganization within the department resulted in the elimination of nonessential procedures and more efficient processes. University-wide workshops were offered to improve departmental understanding of existing and new accounting policies.

Accounting for Related Organizations

Accounting software for related organizations has been upgraded and installed on a new local area network. All endowment accounts were budgeted for the first time. Procedures were reviewed for efficiency and to avoid duplications of effort. Modifications were made to the chart of accounts and reporting formats to make the accounting reports more meaningful to management. Training sessions were offered to users to improve department understanding of new and existing policies and procedures.

Accounting for Fixed Assets

Staff members from Property Control and Accounting Control were merged into a new area to provide a coordinated effort to adequately account for the University's fixed assets and long term debt activity. All procedures have been reviewed and revised to provide for a more efficient operation. New and updated policies on equipment theft and accounting for leases have been issued. Departmental communications have been improved by establishing a departmental fixed asset liaison program.

Facilities Planning and Management

This program area includes planning, project and construction management, and maintenance activities of the University's facilities, including campus master planning, real estate development, property records and capital building projects.

Progress in campus building and renovation programs continues in line with the 10-year facilities plan, representing more than \$300 million in projects initially approved in September 1987 and updated in September 1990. Projects now under construction include the Brackett Hall renovation, the demolition and reconstruction of Johnstone Hall, a student cafe and the Brooks Performing Arts Center. An animal research compliance facility, the Engineering Innovation Building and a renovation of Harcombe Dining Hall are in the design phase. Several projects for agriculture, including a fruit research station, renovations to Newman Hall and Poole Agricultural Center, and a lodging building at the 4-H Cooper Leadership Center have entered the construction phase. A research building housing the Department of Environmental Systems Engineering in the Research Park was completed and occupied in May 1991. The Academic Learning Center (Vickery Hall), East Campus Housing (Lightsey Bridge Apartments), and the T. Ed Garrison Livestock Arena also were completed in the later half of FY 1990-91.

More than a dozen projects consistent with the campus' Capital Renewal and

Replacement Plan were initiated in 1990-91. These included eight reroofing projects, improvements to the heating, ventilation and air-conditioning systems in Poole Agricultural Center and the R.M. Cooper Library, and an upgrade of the electrical system in Poole. Two new parking lots and Phase 1 improvements to the campus storm drainage system began construction in May 1991. Additionally, numerous minor renovations to academic and administrative buildings, including classroom upgrades were implemented.

All departments within Facilities Planning and Management gained access to the new on-line project tracking system and an active training program was initiated. The academic building data collection phase of the Facilities Database update project was completed. This data soon will be loaded into the mainframe computer.

A peer review of the division was conducted in the spring of 1991. Recommendations of the Peer Review Team will assist Facilities Planning and Management efforts to improve its services and to identify new and innovative ways to implement projects on the Clemson campus.

Fiscal Affairs

Capital Financing

The Office of Capital Financing manages and directs the University's long-term capital financing program and financial information system for all present and future University capital projects. Major accomplishments of this office for 1990-91 included:

- Prepared reports and forecasts for the vice president for business and finance, forecasting future revenues for capital financing based on projections of student enrollment, student fees and rental revenues.
- Coordinated the issuance of \$9,925,000 Plant Improvement Bonds to finance Performing Arts Center construction, Lee Hall renovations, and refunding of two prior issues, 1978 and 1984.
- Coordinated the University's first issuance of Auxiliary Facilities Revenue Bonds, totaling \$4 million to finance the renovation of Harcombe Dining Hall and construction of a student cafe.
- Finalized three lease/purchase agreements totaling \$618,714 to finance a new fire truck, bucket truck for Utilities Department, wood chipper and bucket truck for Grounds Department, and upgrade of ID card access system for Business Services.

Purchasing and Supply Services

Purchasing and Supply Services serves and supports the entire University in the procurement of goods and services, information technology and consultant services. In June 1990 Clemson became the first state agency to have its across-the-board certification limit increased to \$100,000.

During 1990-91 the Purchasing Department issued 960 bids and processed 6,300 purchase orders at a value of \$39.7 million. Various agency contracts have been established to allow volume buying and reduce processing time. The University Receiving Station processed 69,033 incoming shipments. The Purchasing Department administered four sealed bid sales during 1990-91, yielding \$4,666.33. An automated procurement system has been developed and is operational, allowing streamlining of the procurement process.

Risk Management and Safety

The Office of Risk Management and Safety provides services in the areas of property and liability insurance, loss control, and safety and workers' compensation. Some major accomplishments of this office during 1990-91 included:

- Established a Radiation Safety Program and hired a full-time Radiation Safety Officer in April 1991.
- Developed and published a new OSHA standard on Laboratory Safety Chemical Hygiene Plan and provided training for all appropriate departments.
- Provided training on the Confined Space Hazard Awareness Program for appropriate departments.
- The Accident Review Board reviewed accidents, screened drivers' licenses for University employees and provided defensive driving for 178 participants.
- Began working on a program manual and have published the following chapters: Respiratory Protection Program, Hazard Communication Program, Laboratory Chemical Hygiene Plan, and Confined Space Hazard Awareness Program.
- One hundred twenty-five contracts were reviewed and 892 claims for workers' compensation, automobile liability, tort liability, fire insurance, data processing, comprehensive and collision, and inland marine insurance were processed.
- The University removed 54,300 pounds of hazardous waste at a cost of \$187,158.60 in 1990-91.

Personnel Management and Development

In February of 1991 the position of associate vice president for personnel management and development was filled as per the Deloitte Touche study. The associate vice president is responsible for overall administration and leadership of the University's non-academic human resource activities including wage and salary administration, payroll, fringe benefits, employee development, employment practices and employee relations programs.

Recruitment and Employee Services

The Recruitment and Employee Services Office serves the employees and administration of Clemson through a variety of programs and activities. Examples of these programs and services include: employment referral services for all non-faculty (staff) positions; employee relations, training and assistance programs; retirement administration counseling services; administration of some employee benefits such as leave, holidays and unemployment; policy development and administration; coordination and distribution of the Personnel Policies and Procedures Manual; maintenance of the official personnel records for the University; maintenance of the personnel database; and the Division of Human Resource Management's database.

Major accomplishments of this department during 1990-91 included:

- Complete reorganization and refocusing of organization. Developed the computerized applicant referral system including a skills inventory. Referred 8,376 applicants for staff positions.
- Initiated and coordinated 1,345 retirement and retirement service credit actions.
- Continued the Pre-Retirement Education Workshops. The computerized Friendly Retirement Education Database (FRED) and the Optional Retirement Counseling Program are continuing efforts for employees.
- Completed revision and awaiting publication of the Personnel Policies and Procedures Manual with the ultimate objective of using the computerized DORIS system to update and communicate the information in the manual.
- Processed more than 32,278 personnel actions. Continue to do direct input into Statewide Human Resource Management.
- With the Division of Administrative Programming Services, developed and currently testing electronic leave system and electronic forms processing.

Employee Development

The Employee Development Department is responsible for providing training seminars, workshops and conferences for all University employees. The department also is responsible for administering the Employee Assistance Program and the Employee Recognition Program. Major accomplishments of this office for 1990-91 included:

- 1990-91 Training Program included two nationally and internationally recognized speakers; Dr. James Belasco and Dr. Larry Sherr. Both speakers focused their presentation on quality improvement issues in the workplace.
- Conducted 34 different seminars/workshops for a total of 56 different sessions.
- Provided Training Needs Survey and SAS analysis of respondents input. In addition, analyzed the data from all participants which was used to design the training program for FY 91-92.
- Total seminar/workshop participants: 1,729 (excluding other Business and Finance workshops). Participant evaluations of the various workshops indicated a very high degree of acceptance.
- Added Apprenticeship Training Program for Facilities Maintenance and Operations as a partnership project.
- Added Associate in Business Training Program for secretarial and clerical employees.
- Initiated steps to produce an on-line computer registration process for training program registration.
- Distributed alcohol and drug policy to all permanent employees. Also included policy and vocational rehabilitation information in New Employee Orientation.
- Counseled and referred 10 employees to vocational rehabilitation or other counselors for advice and guidance.
- Developed formal contact sheet for employee assistance to be used to document employee/supervisor problem and referral given.
- Conducted survey and SAS analysis regarding Employee Service Awards and assisted with the Employee Recognition Program. Formed an Employee Recognition Committee to guide the program.
- Completed final revisions of the "Staff Handbook" with the final formatting which has been sent to the printer.

Payroll and Employee Benefits

The Payroll and Employee Benefits Office provides service and support in the areas of compensation and employee services, the administration of mandatory and voluntary benefit programs for employees, and the management of the University's contribution to all benefit programs. Major accomplishments of this office for 1990-91 included:

- Produced a personalized employee benefits booklet for each permanent full-time University employee, *Your Personal Statement of Benefits 1991*, distributed in April 1991.
- Completed fall enrollment for the state health insurance program with scheduled meetings on campus and at all off campus locations.
- Implemented the new State Optional Supplemental Life Insurance Program through notification to all eligible University employees.
- Reinstated the Medical Spending Account as a benefit through the Money-Plus Flexible Benefits Plan.
- Reviewed and revised the records retention schedule to shorten the retention period of some items and more efficiently retain others through the Division of Archives and Records Management approved microfilm.

- Final stage of the development of a request for proposal to offer University employees a permanent life insurance program through payroll deduction.
- Sorted and distributed W-2 Forms for all active employees with their paychecks, resulting in significant savings in mailing costs for these forms.
- Conducted the second University Benefits Fair to explain employee benefits. Approximately 800 employees participated.
- Continued the Payroll Procedures Workshops to inform administrative employees of appropriate payroll procedures and to assist in their understanding of the payroll/personnel system.
- Revised the VHS orientation tape for new employees to reflect changes in the insurance program and distributed it to all off-campus locations.

Wage and Salary Administration

Wage and Salary Administration provides technical assistance in matters of job classification, compensation and occupational/labor market research to ensure equitable treatment of employees. Major accomplishments of this office during 1990-91 included:

- Invited and participated in Career Day activities at Easley Junior High School.
- Reviewed 502 reclassification/reallocation and salary adjustment requests, 77 hire-above-minimum requests and 692 dual employment requests.
- Researched and evaluated 61 exceptional faculty increases for submission to the state for approval.
- Developed policy on temporary grant positions.
- Enhanced dual employment procedures that employees might be paid in a more timely manner. This was done to comply with new state regulations.
- Implemented new federal minimum wage requirement.
- Analyzed requests for nine exceptional promotion increases, 25 exceptional reclassification increases, and three exceptional reallocation increases.
- Received excellent ratings from audit conducted by DHRM on Clemson's delegated authority.

INSTITUTIONAL ADVANCEMENT

The Division of Institutional Advancement is designed to create and enhance the University's communication and support programs. The division consists of the offices of University Relations, Public Affairs, Alumni Relations and Development. These units work with the University Board of Visitors, the Clemson Alumni Association and the Clemson University Foundation to communicate the mission and activities of the University and to enhance its image; to provide service and programming to Clemson alumni and friends and to seek service and broad support from alumni and friends; to attract and manage private financial gifts in support of Clemson's academic and administrative operations; and to manage the constituent database gift and computer systems necessary for the aforementioned endeavors to occur. A report on each unit follows.

University Relations

Communication is the common theme for the major units and program areas which University Relations comprises. These units provide services in agricultural news and public information, electronic and photographic support, publications and graphics, general public relations counsel, and long-range strategic communications planning for the University's academic and administrative divisions, including the

Cooperative Extension Service and the S.C. Agricultural Experiment Station. The newest department, Historic Houses, reflects the University's long-standing commitment to the preservation and restoration of the John C. Calhoun House and other historic structures on campus.

Agricultural Communications

Agricultural Communications learned just what President Lennon meant in May 1990 when he told a gathering of department heads to do more with less.

Despite severe budget cuts due to the economic downturn, Agricultural Communications initiated a new, very successful training program for county Extension faculty, developed and implemented a revolutionary change in Extension publications designed to generate significant revenue, and converted publications distribution to a sophisticated, on-line system.

Shuffled among those triumphs were the successful dedications of the Institute of Wildlife and Environmental Toxicology research facilities in Pendleton and Hampton County plus the T. Ed Garrison Livestock Arena, the downsizing reorganization of the department, a public relations strategy for Extension's proposed furlough and related budget woes, and significant progress toward improvement of air quality in the P&A Building after three decades of problems.

We opened the door to needed coordination between county Extension offices and Institutional Advancement's development and governmental relations arms and established regular coordination between the media relations operations in Agricultural Communications and News Services.

The need for communications training in county Extension offices was significant. We put together a program of county-based training, sending a team of editors and artists to each of the 10 highest-priority counties for the first year of the program.

The Extension publications program is a large operation: 1,700 titles in stock, 400-600 publications projects a year, about a million pieces shipped from campus to counties and other targets annually.

During the past 18 months we worked out an on-line ordering system for county Extension offices, eliminating mail orders, phone orders and other ineffective methods. In May 1991 we converted all county publication orders to the new, automated system. A county places an order, our inventory is adjusted, a shipping label is printed, and the order is filled within one day. If a requested publication is out of stock, the county gets a message to that effect. If the supply is running low, the originating department gets that word.

As Extension's budget situation worsened during February and March 1991, we developed a plan to offer some of our more popular publications for sale. That turned into lots of consultation with colleagues in other states, pricing formulas, cash incentives to originating departments, policies and a new accounting system. Our first new for-sale publications, a home vegetable gardening guide and a manual for xeriscaping (minimal irrigation landscaping) are on the market; more will follow soon.

Extension spent at least \$273,000 last year on publications. We will make a serious dent in that operating cost in the next fiscal year. Our five-year objective is to be generating revenues for other elements of the Extension program.

The economic downturn hit our department hard, with three key professional-level vacancies (broadcast news editor, print production manager and graphics supervisor) since March 1991. Those positions are frozen, if not lost. Additionally we sliced our student worker corps from 10 to one in late fall and froze travel in February.

Faced with options to limp along until the budget improved or reorganize, we opted for reorganization of our news and publications divisions, downsizing for the three vacancies.

A careful reassessment of assignment priorities has enabled us to remain focused on our mission and make the most effective use of resources. Casualties in-

clude some carefully nurtured initiatives in radio and television news, short publications project turnaround time plus the production of exhibits with the exception of a scaled-back State Fair display.

Our publications production staff losses coincided with a reduction in demand, also caused by the budget crunch. With graphic artists and publication editors handling all the print production tasks involved in specifications, bidding, press proofing and delivery, we will be unable to meet increased demand without additional personnel.

We took a very conservative approach to fiscal management because of the oft-changing budget picture. Including lapsed salary money, which we could not control, we completed the fiscal year \$37,481 in the black, despite budget cuts of \$47,138 to our operating accounts during the fiscal year.

Production statistics showed some volatility in comparison with previous years. Budget cuts and the conclusion of Extension's four-year program cycle took their toll in publications, as publications project volume slid from 588 in 1989-90 to 396, a five-year low. Bulletin Room distribution of Extension, Experiment Station and USDA publications also fell from 1,291,625 in 1989-90 to 972,923, with the biggest drop in Extension. Three of the past five years have been remarkably consistent in Bulletin Room distributions, with spikes in 1988-89 and 1989-90, attributed to large 4-H shipments.

News release volume reached a five-year high, with 421 Extension releases and 71 Experiment Station releases issued for a total of 492. August, February and May news release totals were the best in five years.

Electronic and Photographic Services

The Department of Electronic and Photographic Services (commonly known as the Communications Center) provides a broad range of audio and visual production services to support the public service, administrative, development, research and instructional activities of the University.

Services include television, audio, multi-image, photographic, motion picture production, audio and video teleconferencing, art and graphic support, and audio-visual equipment and resources loans.

In 1990-91 the department:

- Produced 569 television program units.
- Produced more than 70,000 photographs.
- Completed more than 3,000 art and graphics jobs.
- Produced 260 daily "Plant Professor" radio programs and 52 "Living Well" programs distributed to stations statewide.
- Produced 40 multi-image presentations.
- Increased the media library's holdings to 2,310 titles and averaged more than 75 loan transactions per week.
- Complied with an average of 80 requests per week for items from the audio-visual equipment loan service.

Publications and Graphics Services

The Department of Publications and Graphics Services provides collateral materials that support the University's efforts to recruit students, faculty and staff; develops materials to enhance the fund-raising efforts; produces advertising-oriented promotional materials for campus events; and is responsible for consistent implementation of the University's identity program in publications.

In 1990-91 the department completed 486 jobs. This is an increase over last year's 322 jobs and carried over 83 jobs into the new fiscal year. Total production costs were \$611,405.73, down from last year's total of \$657,225. Publications and Graphics produced 25 percent more for 7 percent less, partly because of equipping the department to become more efficient and capitalizing on emerging technology in the printing industry. Most of the larger projects are now sent directly to the printer

on disk, eliminating the costly and time-consuming paste-up process. Secondly, since all colors are separated on the computer, this saves costly stripping of negatives in the pre-press process and thus lowers printing costs. The equipment purchases made through reallocating budgets has more than paid for itself through production increases and cost savings to the University.

This year, Publications and Graphics has attempted to do more, do it better, for less money and in less time. Several things have contributed to meeting those goals. First, a time management program was instituted. Second, a more fully computerized job management system was developed. (This was developed in FY 90-91 and instituted at the beginning of FY 91-92.) Third, relief money was requested on projects that traditionally would have been sent to agencies. With this relief money, temporary help was hired to work in-house at a fraction of agency prices. Fourth, we have attempted to maximize the utilization of our computer system so it can do everything for us that it is capable of doing. Fifth, we saved a considerable amount of money by analyzing our phone needs and requesting and using 800 numbers whenever possible.

The biggest project for the year was a complete revamp of the two premier admissions publications. The project started at square one. Staff went to the high schools and held focus group interviews and held interviews with Clemson students to see how they responded to the questions and comments of high school students. This information then was analyzed, and it was determined what Clemson's publications must communicate both verbally and visually to make them competitive in the national marketplace. Staff wrote and designed the publication based on this analysis, then went back to high school students and tested it for effectiveness. The publication was scheduled to be delivered in August. Since this is a very tight budget year, the budget for the publications was exactly at last year's prices. The combined bids came in \$2,200 under last year's bid. (Final figures after press modifications may bring the total cost close to budget, but not over.) As rewarding as this effort has been in terms of the quality of the publications, the process was equally rewarding. A team spirit was built with the Admissions Office, and it was a cooperative effort, with all involved providing input and becoming active participants in the process. This project resulted in better working relationships for the future and improved client satisfaction.

Two projects were begun during the year that apply the same marketing techniques to graduate recruiting as to the undergraduate project. Both Plant Sciences and Engineering are in progress and will continue into the next fiscal year.

Publication support for the Campaign for Clemson has included displays and publications for the goal announcement luncheon, production of a complete package of materials for the Fluor Daniel Campaign, and contributions to the marketing/communication plan for the Loyalty Fund.

Staffing through the last year has held constant. David Dryden joined the design staff. Rachel Mumford was on six-month leave, and Sandra Parker also departed for a six-month maternity leave. Stacie Green has been hired as a temporary replacement for Sandra through December 16, 1991.

Board of Visitors

One of the key volunteer groups which serves the University's institutional advancement program is the Board of Visitors. Through this program, 40 prominent business leaders serve as advisers to the University during two-year terms, visit the campus for updates on programs and priorities, and help provide a two-way communications link between the University and the public in their respective communities. The program is an important vehicle to involve key leaders in the University where no other opportunity may exist.

During the year the Board established two annual \$500 Awards of Excellence, funded through gifts from members of the Board of Visitors, for graduate teaching assistants. For some time the Board of Visitors has been interested in an initiative that not only would demonstrate its interest in and support of undergraduate educa-

tion of the highest quality at Clemson, but also would help to improve the undergraduate education experience. First recipients were Tim Slater and Marilyn Knight.

Members of the Board of Visitors are nominated by the Board of Trustees and appointed by the president. They are assigned to four working committees: academic affairs, legislative relations, media and research.

Historic Houses

An interdisciplinary approach during the past year has upheld the vision of promoting education and institutional fund-raising through the University's historic houses. Students, faculty and staff from the University departments of Architecture, History, Development, Facilities, Publications and Graphics, Education, Parks, Recreation and Tourism Management, Languages, Fine Arts, Communications, Horticulture, Textiles, Agriculture and Building Science have been involved in advancing the Historic Houses mission, which is to present the houses in a posture that will foster a public understanding of the origins of the University within the context of the rich heritage of the state and nation.

During the past year:

- The John C. Calhoun House Museum was open to the public 361 days, and more than 23,000 visitors toured the house and grounds.
- The Hanover House Museum continued to be open to the public every weekend, during the Historic Houses Holiday Celebration and during National Historic Preservation Week in May.
- The Historic Houses Advisory Committee was appointed, chaired by Professor Gordon Halfacre, and composed of 16 faculty, deans and administrators from several University departments.
- A "shared" faculty member was hired by Historic Houses and the College of Architecture. Carrel Cowan-Ricks is an African-American archaeologist who will be developing a new field of study at Clemson.
- The education coordinator for Historic Houses was hired. Will Hiott has hired and trained site guides, developed two exhibits and established interpretation programs at the Hanover and Calhoun Houses.
- More than 75 volunteers from the Lake & Hills, Cherokee and Foothills Garden Clubs contributed their talent, time and money to the Holiday Celebration.
- Publications design standards were established and the following produced: visitors guides to Hanover and Calhoun Houses, "African Americans at Fort Hill," "Women at Fort Hill" and house museum tourism rack cards.
- An audio-visual program was developed as a fund-raising tool for the Calhoun House.
- Cultivated and received 10 percent of The Campaign for Clemson goal for Historic Houses.
- Developed and delivered seven proposals to state and federal funding sources.
- Identified major donors for the Calhoun House, Trustee House, Hopewell and Hanover House.
- Developed a reuse plan for Hopewell, coordinated with the Agricultural Experiment Station and the College of Architecture.
- Admission donations commenced being requested and assisted in supporting student historic site guide training and employment as well as museum publications.

Public Affairs

In January 1991 Communications and External Relations was renamed Public Affairs. Our mission remains the same — to facilitate accurate, frequent, productive

and widespread communication with internal and external audiences of the University and to facilitate the positive image of Clemson. Our ability to accomplish this mission was enhanced in 1991 with the transfer of the Public Affairs Office in Columbia to the larger Public Affairs group. This transfer will allow for greater coordination of our government relations and public relations efforts. Such coordination will be of particular importance to the University as the state faces severe budget constraints.

Public Affairs expanded and improved its communications efforts in 1991 through the coordination of the preparation of the president's annual report and the launching of a new faculty/staff newsletter, *Inside Clemson*. News Services' work on a variety of events and issues resulted in continued confidence among the president, vice presidents, deans and department heads in the services provided by the Department of Public Affairs.

A combination of a severe budget crunch, increased media scrutiny of institutions of higher education, and increased competition for students and faculty has resulted in a greater awareness on campus of the need for a sound communications, government relations and public relations strategy. Public Affairs is ready to develop and implement that strategy.

News Services

The Department of News Services provides the University with a means of communication to the public through the external news media. Staff members generate news and feature stories about the University's education, public service and research programs for use by state, regional and national news media and in constituent publications. Services also include editing and marketing faculty-written columns and reviews; coordinating coverage of campus events, speakers and Board of Trustees meetings; conducting news conferences and major public relations campaigns; advising University administrators of media relations issues; acting as liaisons between the University and the print and broadcast media; serving as spokespersons for the University to the news media; and providing media training for Clemson faculty, staff and administrators.

Products and services of the department in 1990-91 include:

- Strategic Public Relations Planning
 - University Communications Plan
 - News conferences and other media events
 - Individual project media plans
 - Editorial Calendar
- 555 news releases
- Briefs columns
 - News Briefs (distributed statewide twice monthly)
 - Business Briefs (distributed to business page editors monthly)
 - Events (distributed to cultural affairs page editors monthly)
- Student News Program (4,246 hometown news releases in 1990-91 on students who earned scholarships, made the Dean's List, or achieved other awards and honors)
- Info-graphics (Macintosh-generated)
- Special feature packets
 - Hurricane Hugo: One Year After
 - Back to School
 - Persian Gulf War (stories, sources list prepared in advance and distributed the day deadline was set for withdrawal from Kuwait; war began two days later)
 - Christmas
- Monthly national feature packet
- Faculty-written op-eds and columns
- Tip sheets

- What's Happening at Clemson (weekly listing of events)
- What's Happening Next Month (monthly calendar format tip sheet)
- Clemson Daybook (daily tip sheet listing events, story ideas and sources on breaking news stories)
- "Who Knows" media sources guide
- Media Training for faculty, staff, administration
- Crisis Communications
- Media Relations
 - "Welcome Back" picnic for reporters who cover Clemson regularly
 - 3,464 individual media contacts
 - Editorial briefings for administrators (Anderson, Greenville, Columbia, *The Tiger*)
 - Personal visits to each daily newspaper in South Carolina.
- Special Projects
 - The Clemson Poll on Local Government
 - Third Thursday at the Thurmond Program on "the media in transition"
 - Hurricane Hugo media conference (cosponsored with CHAMP)

Constituent Communications

The role of the Constituent Communications program is to help the University keep constituent audiences (primarily alumni, faculty, staff, donors and other supporters) informed about and involved in Clemson.

The major "products" of this effort are four periodical publications:

- *Clemson World* magazine (circulation 23,000)
- *Clemson World News* tabloid newspaper (circulation 85,000)
- *Clemson Weekly* faculty/staff newsletter (circulation 4,000), and
- The Campaign for Clemson *Partnership Report* (circulation 1,500 donors).

Staff members also provide editorial and communications counsel and support for special projects, such as the \$78 million Campaign for Clemson. In FY 1990-91 the program:

- Completed a six-month process to develop and launch a totally revamped faculty/staff publication. A new biweekly tabloid called *Inside Clemson* replaced *Clemson Weekly* as of July 19, 1991. In developing the new publication, ideas were sought from the campus community, a prototype was developed and tested with focus groups, and the new concept was presented to a dozen campus groups and administrative units.
- Completed a readership survey of *Clemson World* readers. This project — a telephone survey of 400 alumni — was accomplished with the help of a graduate student in mathematical sciences, and the results are being used to improve the appearance and editorial content of the magazine.
- Prepared and published four issues each of *Clemson World* and *Clemson World News*.
- Prepared and published more than 40 issues of *Clemson Weekly* and companion "news specials" for the internal audience.
- Assisted the president, vice presidents and other administrators with special communications projects, as needed, including the "President's Report," *President's Letter* (a biweekly newsletter) and other media.
- Provided leadership for communicating the public announcement of The Campaign for Clemson interim victory celebration on Feb. 25, 1991, when the original goal of \$62 million was reached.
- Handled the internal/constituent component of special communications efforts such as the budget crisis.
- Assisted Alumni Relations and the Development Office with special communications and newsletters for major donors and Clemson Club officers.

- Sponsored a very successful video conference on "Making Your Newsletter More Effective" for campus newsletter editors.

Public Affairs — Columbia Office

The Public Affairs Office in Columbia is the on-site liaison for the University to all branches of state government, including the General Assembly, the Governor's Office and other state agencies. The office coordinates all interaction between the University and state government officials; provides timely and accurate information about University programs and priorities to legislative and executive branches of state government; keeps campus decision makers informed and offers advice regarding relevant state government action and policies; constructively involves key executive officers and faculty in legislative strategies and communication; and carries out the plans and strategies determined by the president and executive officers of the University to be in its best interest.

To keep the campus informed of Columbia activities, the Public Affairs Office began distributing a weekly briefing report on state government activities. The report, which was published while the General Assembly was in session, was very useful in coordinating campus efforts in regard to several pieces of legislation.

On January 1, 1992, the Public Affairs Office in Columbia will be relocated to Clemson. This move, which will save approximately \$38,000 a year, will improve coordination of the University's government relations program. As the University grows and becomes a more complex institution, it is vitally important that our government liaison staff be well-informed about University events, policies and plans for the future. That is difficult to accomplish when the staff is not located on campus. We want our staff members to participate in planning and developing as well as carrying out our government relations program, which requires that Clemson be the home base rather than Columbia.

1991 Session of the General Assembly: The General Assembly adjourned sine die at 5 p.m. on Thursday, June 6. State law provides for adjournment on that date unless both Houses vote to extend the session. During the waning hours of the assembly the leadership of both the House and Senate tried to reach agreement on the terms of an extended session (i.e. how long such a session would last, and what legislation would be considered during the session). They could not reach agreement before the statutorily prescribed time of adjournment. Left unresolved at the time of adjournment was the Capital Improvements Bond Bill. The legislature was reconvened by the governor for an extended session on September 23 and 24 and passed the Bond Bill along with ethics legislation.

The passage of the Bond Bill was of particular concern to the University. The Bond Bill contains \$13,065,000 for our Engineering Innovation Center, \$4,406,000 for our animal compliance facility and \$242,000 for badly needed equipment for our diagnostic lab in Pontiac at the Sandhill Experiment Station.

Appropriations Bill: The final budget of the University for the fiscal year beginning July 1, 1991, suffered a blow when the conference committee on the state appropriations bill cut 3.3 percent across-the-board from the level of funding that previously had been agreed to by the committee. The cut was in response to revenue figures from the Board of Economic Advisors that showed state revenues significantly lower than had been expected.

The final version of the bill passed both Houses and was signed by the governor with only minor line item vetoes. Final figures for Clemson were \$79,360,878 for our E & G Budget and \$43,783,930 for our PSA budget. On July 30, 1991, the Budget and Control Board ordered state agencies, including Clemson, to cut their budget 1 percent and also to set aside 2 percent of their budgets in an escrow account, which may be released in the event the economy improves.

Between May 14, 1991, and July 30, 1991, the Budget and Control Board also

instituted a freeze on spending by state agencies. The freeze included supplies and equipment and personnel.

A number of needed regulations were approved by the legislature this year. These included regulations affecting chemigation, boll weevils, bees, structural pest control and equine infectious anemia. In addition we were successful in our effort to pass a bill facilitating the collection of money under the boll weevil eradication program.

Alumni Relations

The focus of the Alumni Relations program continues to be on service. During 1990-91 a number of new programs were created, as well as a concerted effort made to enhance the service element of existing programs. The following list highlights the alumni program for the past year:

- Fifty-seven Clemson Club meetings were held across the country, in addition to 125 Young Alumni events such as happy hours, viewing parties, barbecues, lake parties and harbor cruises.
- Regional leadership meetings were held for the first time in nine locations across the state and region to bring alumni volunteers together to make plans for future alumni activities in the area.
- Chartered Clemson Clubs increased from 26 to 39. Active clubs now number 79.
- The first annual Clemson Club President's Appreciation Weekend was held on campus, with 44 attendees representing 20 clubs.
- The Greenville luncheon club grew; the Columbia luncheon club came under the direction of the Alumni Office; and a breakfast club was established in the lowcountry, meeting in Charleston. Each group attracted dozens of alumni who previously had not attended an alumni function.
- Young alumni representatives on the Young Alumni Council increased from 33 to 48.
- A Young Alumni Memorial Endowment was established to honor deceased young alumni.
- An alumni headquarters was hosted at all five away games, serving more than 1,400 alumni and friends. The alumni package at the Hall of Fame Bowl served 325 alumni and friends.
- Constituency reunions were held for former Student Body Presidents, Clemson Alumni Physicians and Dentists, Former Cheerleaders, Alumni Band and Clemson Black Alumni.
- The Women's Council program developed a brochure to offer membership to any interested female, alumnus or student. Initial response has exceeded 700. Women's Council added student members and sponsored an educational seminar for alumni/friends on "Choice Management."
- The Parents' Program continues to expand. The Parents' Council Advisory Board met twice during the year and helped develop Parents' Weekend '91. Parents' Weekend '90 was well attended, with more than 4,000 participants. Also, Parents' Council members participated in a panel during new student orientation sessions.
- Student Alumni Council (SAC) hosted luncheons to educate students on what the Alumni Association is, and what it does. More than 60 students attended. Also SAC held the first "Young Alumni Awareness Day" on the loggia, with video and posters. More than 800 students came by the booth for more information on Young Alumni chapters across the country.
- Hosted the first Corporate Luncheon Club at Duke Power headquarters in Charlotte. Forty-five alumni attended. Meetings will be held twice a year.
- Organized a college alumni advisory group made up of representatives

from each college that will meet quarterly to capitalize on a partnership between the Alumni Office and the respective college in building stronger alumni relations.

- Held high school academic recruiting meetings in six locations with approximately 350 prospective students and their parents in attendance.
- Coordinated all activities for the president's box (250 in attendance for each game), medallion dinner (425 people in attendance), graduation luncheons (500 people in attendance), new faculty orientation reception, Keowee Key Clemson Club trip to Spoleto (49 in attendance), and the summer reunion program (658 alumni in attendance.)
- Presented the 1991 Distinguished Service Awards to Jack Day, John Mundy, Frank Barnes, Harvey Gantt and Ted Pappas.
- Coordinated 68 Institutional Advancement receptions/luncheons/dinners.
- The Alumni Association took full responsibility for marketing the Clemson license tag program. During the first six months of 1991 more than 700 tags were sold, which brought \$6,552 to the Clemson Scholars Program.
- The Clemson Credit Card continued to perform well, surpassing the \$500,000 mark in revenue to the Alumni Association Endowment in April 1991, only three years after it was introduced. More than 10,000 cards are actively being used by Clemson alumni and friends.
- The CollegeSure CD program was introduced to approximately 25,000 alumni, friends, staff and donors. Response was excellent at more than 5 percent. (Average response rate is 2 percent.)
- The Passport Travel program served more than 140 prospective travelers. Six trips during the year generated gross income of \$16,477. Response from travelers was excellent. Also, the first educational travel seminar of its type was hosted by the Alumni Association with more than 40 participants learning more about Japan from two professors.
- The University Visitors Center welcomed more than 20,000 visitors to our campus last year, guided 410 tours, and arranged 207 school and community tours. The center also developed a system for both identifying potential prospective students and notifying each college's recruiter in an effort to assist with new student recruitment. A new tour videotape for prospective students was completed. Also, the center began participating in each new employee training session to better familiarize them with the University.

Development Office

The objectives of Clemson's private support efforts are deliberate and broad-based. They encompass growth in the unrestricted permanent endowment, expansion of all phases of general and endowment support for faculty, increased sources of student financial aid and further development of the annual Loyalty Fund program, which enhances the total academic environment. While state appropriations are a part of the total support for the educational activities at Clemson, more than 50 percent of the total budget must come from other sources. In that context the ultimate quality of the University rests with private support from business, industry, alumni and friends of the University.

In 1990-91:

- Private gifts for Clemson's academic programs jumped 11 percent, reaching \$16.1 million and crossing into double digits for the fourth consecutive time.
- Unrestricted giving to the annual Clemson Loyalty Fund reached \$1.2 million.
- 13,928 individuals made 17,672 gifts to current operations or endowments. The average of these gifts was \$324.

- Of Clemson's alumni on record, 23.5 percent — significantly higher than most state-assisted schools — participated in the Loyalty Fund. Clemson continues to stress involvement at all levels in its annual giving programs.
- 2,054 donors made gifts to Clemson for the first time.
- Of the \$16.1 million total, \$5.75 million came from individuals, \$10.35 million from corporations, foundations and trusts.
- A total of 18,674 gifts — including gifts for annual operations and for capital purposes, from individuals and from organizations — were received in 1990-91. The average gift from all sources was \$864, up 12 percent from last year.
- Total expenditures relative to year-end fund-raising results indicate a cost of 11.93 cents to raise each dollar. This was down from the 12.62 cents cost of a year ago. The national average for all colleges and universities is 16.5 cents.

The year was highlighted by several large contributions from both individuals, corporations and foundations.

STUDENT AFFAIRS

The 1990-91 academic year marked the highest (total) University enrollment with 16,303 students registered for classes — 13,765 full time and 2,538 part time. This represents an increase of more than 1 percent from last year. Of the total enrollment, 3,293 were graduate students.

The College of Commerce and Industry had the highest collegiate enrollment with 3,909 students. The College of Engineering was second with 3,781, followed in order by Education (2,465), Sciences (1,652), Liberal Arts (1,826), Agricultural Sciences (879), Architecture (719), Forest and Recreation Resources (536) and Nursing (393).

Higher education continued to become increasingly accessible as evidenced by the number of freshmen entering college with advanced standing. In the 1990-91 fall semester, new high school graduates entered Clemson with advanced standing by means of College Board Advanced Placement courses (724 students, 6,897 credit hours) and by concurrent enrollment in high school and college or enrollment in summer school (219 students, 1,218 credit hours).

At Clemson, performance in high school has proven to be the best single predictor of success in the freshman year. The class ranks of entering freshmen improved somewhat, with 38 percent of the class entering in fall 1990 ranked in the top 10 percent of their class, 63 percent in the top 20 percent and 94.5 percent in the top 50 percent. The freshman class average Scholastic Achievement Test (SAT) score of 1,035 compared with an average of 900 reported by the College Board for all high school seniors. It also is the highest average among state-supported institutions in South Carolina. Of the 9,299 new applications for admission processed for 1990-91, 6,199 were accepted, and 3,157 actually enrolled (including freshmen and transfer students).

Clemson students come from all 46 S.C. counties, 47 states, Puerto Rico, the District of Columbia and 69 foreign countries. S.C. residents accounted for 67.7 percent of the 16,303 students. Greenville County continued to have the most students enrolled (1,789). Anderson County was second with 1,144, followed in order by Pickens, Oconee, Spartanburg and Lexington counties. Most out-of-state students came from Georgia (553), Florida (472) and North Carolina (443).

Computerized preregistration helped the record number of students get off to a smooth start for fall classes. Approximately 86 percent were preregistered and had their course schedules completed before they arrived on campus to begin classes.

Fall Semester Enrollment Comparisons for Recent Years

| Year | Undergraduate | Graduate and Others | Total |
|---------|---------------|---------------------|--------|
| 1972-73 | 7,686 | 2,071 | 9,757 |
| 1973-74 | 7,910 | 2,202 | 10,112 |
| 1974-75 | 8,171 | 2,415 | 10,586 |
| 1975-76 | 8,576 | 2,785 | 11,361 |
| 1976-77 | 8,620 | 2,763 | 11,383 |
| 1977-78 | 8,708 | 2,566 | 11,274 |
| 1978-79 | 8,925 | 2,553 | 11,478 |
| 1979-80 | 9,291 | 2,457 | 11,748 |
| 1980-81 | 9,427 | 2,152 | 11,579 |
| 1981-82 | 9,918 | 2,008 | 11,926 |
| 1982-83 | 10,151 | 1,983 | 12,134 |
| 1983-84 | 10,217 | 2,242 | 12,459 |
| 1984-85 | 10,488 | 2,438 | 12,926 |
| 1985-86 | 10,434 | 2,459 | 12,893 |
| 1986-87 | 10,360 | 2,702 | 13,062 |
| 1987-88 | 10,970 | 2,895 | 13,865 |
| 1988-89 | 11,774 | 3,020 | 14,794 |
| 1989-90 | 12,563 | 3,509 | 16,072 |
| 1990-91 | 13,010 | 3,293 | 16,303 |

The enrollment of women at Clemson reached an all-time high during the 1990 fall semester. There were 7,045, of which 5,555 were undergraduates. Enrollment of undergraduate women increased more than 2 percent from last year, and women continue to constitute approximately 43 percent of the undergraduate enrollment.

The Clemson student body continues to be a working group, receiving a significant amount of financial assistance through loans, grants, scholarships and employment. Clemson awarded 663 long-term loans totaling \$890,100. The University also approved and certified 2,747 guaranteed student loans with a total value of \$6,419,158 from a variety of lending institutions. Excluding donor-selected scholarships, 2,424 scholarships and grants valued at \$4,575,039 were awarded. The number of students receiving Pell Grants was 1,806 with awards totaling \$2,650,361. In all, about 55 percent of the undergraduate student body received an estimated total of \$23 million in financial assistance.

| Number and Percent of Black Students | | | Average College Board of Freshmen | |
|---|--------|---------|--------------------------------------|-------|
| Year | Number | Percent | Year | Score |
| 1972 | 179 | 2 | 1972 | 995 |
| 1973 | 211 | 2 | 1973 | 982 |
| 1974 | 216 | 2 | 1974 | 984 |
| 1975 | 338 | 3 | 1975 | 983 |
| 1976 | 307 | 3 | 1976 | 996 |
| 1977 | 336 | 3 | 1977 | 985 |
| 1978 | 290 | 3 | 1978 | 1,000 |
| 1979 | 341 | 3 | 1979 | 1,002 |
| 1980 | 305 | 3 | 1980 | 1,005 |
| 1981 | 325 | 3 | 1981 | 1,007 |
| 1982 | 429 | 4 | 1982 | 1,017 |
| 1983 | 472 | 4 | 1983 | 1,014 |
| 1984 | 528 | 4 | 1984 | 1,012 |

| | | |
|------|-------|------|
| 1985 | 671 | 5 |
| 1986 | 714 | 5.47 |
| 1987 | 690 | 5 |
| 1988 | 789 | 5.3 |
| 1989 | 1,004 | 6.2 |
| 1990 | 1,075 | 6.6 |

| | |
|------|-------|
| 1985 | 1,012 |
| 1986 | 1,025 |
| 1987 | 1,028 |
| 1988 | 1,032 |
| 1989 | 1,025 |
| 1990 | 1,035 |

**Student-Faculty Ratio
(Full-Time Equivalent)**

| Year | Ratio |
|------|--------|
| 1972 | 14.6:1 |
| 1973 | 16.8:1 |
| 1974 | 17.9:1 |
| 1975 | 18.3:1 |
| 1976 | 17.6:1 |
| 1977 | 16.3:1 |
| 1978 | 15.9:1 |
| 1979 | 16.0:1 |
| 1980 | 15.6:1 |
| 1981 | 16.4:1 |
| 1982 | 16.6:1 |
| 1983 | 17.0:1 |
| 1984 | 16.1:1 |
| 1985 | 15.4:1 |
| 1986 | 16.9:1 |
| 1987 | 18.3:1 |
| 1988 | 18.9:1 |
| 1989 | 19.7:1 |
| 1990 | 19.8:1 |

**Number in Freshman Class
(New Students)**

| Year | Freshman |
|------|----------|
| 1972 | 1,919 |
| 1973 | 2,034 |
| 1974 | 1,949 |
| 1975 | 1,901 |
| 1976 | 1,861 |
| 1977 | 1,838 |
| 1978 | 2,020 |
| 1979 | 1,998 |
| 1980 | 2,008 |
| 1981 | 2,284 |
| 1982 | 2,321 |
| 1983 | 2,122 |
| 1984 | 2,188 |
| 1985 | 2,259 |
| 1986 | 2,239 |
| 1987 | 2,818 |
| 1988 | 2,885 |
| 1989 | 2,900 |
| 1990 | 2,513 |

**Number of Teachers
(Full-Time Equivalent
Teaching Faculty)**

| Year | Teachers |
|------|----------|
| 1972 | 614.9 |
| 1973 | 578.4 |
| 1974 | 591.8 |
| 1975 | 602.5 |
| 1976 | 611.3 |
| 1977 | 654.4 |
| 1978 | 675.6 |
| 1979 | 691.8 |
| 1980 | 718.2 |
| 1981 | 709.7 |
| 1982 | 720.9 |
| 1983 | 713.5 |
| 1984 | 762.5 |
| 1985 | 797.3 |
| 1986 | 731.24 |
| 1987 | 713.93 |
| 1988 | 755.48 |
| 1989 | 769.33 |
| 1990 | 791.31 |

**Number of On-Campus Students
in Summer School**

| Year | Number |
|------|--------|
| 1972 | 5,232 |
| 1973 | 6,267 |
| 1974 | 5,997 |
| 1975 | 6,275 |
| 1976 | 6,100 |
| 1977 | 6,301 |
| 1978 | 6,393 |
| 1979 | 6,708 |
| 1980 | 6,858 |
| 1981 | 6,897 |
| 1982 | 7,149 |
| 1983 | 7,442 |
| 1984 | 7,418 |
| 1985 | 8,126 |
| 1986 | 8,562 |
| 1987 | 8,446 |
| 1988 | 8,689 |
| 1989 | 9,039 |
| 1990 | 9,873 |

The Office of Student Development experienced significant changes in personnel. The director and four other staff positions were filled within the past year. Through the influence of this new staff, the Office of Student Development will be energized with new ideas and new projects in the coming year.

This past year was the first year of a two-year federally funded grant to provide alcohol education programs to Clemson students. Student peer counselors were trained and presented dozens of programs both on campus and in upstate communities. Concern for addressing the problem of alcohol use and abuse continues to be a major programmatic effort for the coming year.

Student organizations, now numbering more than 250, are ever active in providing leadership experiences for their members. Leadership development through student advising, organizational experiences and the Clemson Leadership Awareness Seminars for Students (C.L.A.S.S.) offer students outstanding opportunities to develop life-long leadership skills.

Services for minority students continued through the efforts of the Office of Student Development staff. Black History Month programs, Black Male and Black Female Emphasis weeks and programs for Black Students of Promise were refined and implemented during this past year.

As the number of students with handicaps increases, the Office of Student Development serves as the point of special assistance and guidance for these students. Adjustments in schedules and facilities are arranged through the office staff to insure that handicapped students are being successful at Clemson.

A record 1,711 students registered with the Career Center for full-time employment and 778 registered for internships. By spring we were feeling the effects of the recession with the number of employers recruiting on campus down 23 percent. To help students cope with the downturn in the economy, workshops on job search skills were expanded and special programs such as Black Career Success Night were instituted. More than 700 students took advantage of the free service to put their resume into a national network which resulted in employer contacts for many of these students.

The Counseling Center has continued its successful effort to provide therapeutic and educational opportunities to students. In the past year, the center has expanded its group counseling offerings, increased the number of counselor hours available to individual sessions, and introduced a new series of self-management workshops for students. The response from students has been very positive, with the demand for services increasing markedly in the past year. With the addition of more staff, the center plans to expand its counseling activities, targeting more minorities and special populations within the campus.

The Clemson University Union had another outstanding year in 1990. A total of 804 events were programmed and produced by University Union student volunteers, with a combined attendance of more than 92,000. It was truly an exciting time at the Union as more than 250 students were recruited and provided the opportunity to make a difference at Clemson this past year.

This year's highlights included sold-out performances by such notables as the Harlem Boys Choir, jazz musician Richard Elliot and blues legend John Hammond. The Third World Student Programming Alliance presented leading speaker Maya Angelou to a standing room only crowd. Add these to a stimulating appearance by football legend Terry Bradshaw and a top ten finish by our College Bowl team at the regional competitions, and you can see that we've had a great year. And we are even more excited about the upcoming year!

For the first time ever Clemson's all-around sports program finished among the top 15 in the nation in both men's and women's competition for the 1990-91 academic year. The men's program ranked seventh in the nation while the women's program finished 13th in the nation.

Clemson was one of eight schools to have both its men's and women's programs ranked in the top 15 of each poll. Clemson had five ACC Coach of the Year selections, won both of the ACC's top student-athlete awards in 1990-91, had 64

players selected to the Academic All-Conference team, three ACC Players of the Year, 27 All-Americans, and 62 All-ACC.

| Year | Number of Dorm Beds and Percent Being Used | |
|------|---|---------|
| | Beds | Percent |
| | 1975 - 262 | |
| 1972 | 5,174 | 100 |
| 1973 | 5,330 | 102 |
| 1974 | 5,592* | 101 |
| 1975 | 5,616* | 103 |
| 1976 | 5,625* | 103 |
| 1977 | 5,662* | 103 |
| 1978 | 5,683* | 104 |
| 1979 | 5,726* | 106 |
| 1980 | 6,317* | 112 |
| 1981 | 6,864* | 100 |
| 1982 | 7,149* | 105 |
| 1983 | 7,113* | 104 |
| 1984 | 6,976* | 102 |
| 1985 | 6,986* | 102 |
| 1986 | 6,910* | 101 |
| 1987 | 7,047* | 103 |
| 1988 | 7,125* | 104 |
| 1989 | 6,992* | 102 |
| 1990 | 7,024* | 104 |

**Includes beds in the
Clemson House*

1974 - 252
1975 - 262
1976 - 271
1977 - 308
1978 - 317
1979 - 324
1980 - 329
1981 - 330
1982 - 328
1883 - 331
1984 - 331
1985 - 333
1986 - 349
1987 - 360
1988 - 362
1989 - 366
1990 - 383

**Fall Semester 1989 Enrollment by Colleges and Degrees Awarded
December 1989-August 1990**

| | Total Enrollment Fall Semester | Degrees | | | | | Total |
|---------------------------------|---|------------------|-------------------|-----------------|-------------------|-------------------|--------------|
| | | Associate | Bachelor's | Master's | Specialist | Doctorates | |
| Agricultural Sciences | 879 | 0 | 62 | 50 | 0 | 16 | 128 |
| Architecture | 719 | 0 | 111 | 64 | 0 | 0 | 175 |
| Commerce and Industry | 3,909 | 0 | 604 | 142 | 0 | 7 | 753 |
| Education | 2,465 | 0 | 258 | 205 | 8 | 3 | 474 |
| Engineering | 3,781 | 0 | 405 | 127 | 0 | 27 | 559 |
| Forest and Recreation Resources | 536 | 0 | 80 | 11 | 0 | 5 | 96 |
| Liberal Arts | 1,826 | 0 | 256 | 24 | 0 | 0 | 280 |
| Nursing | 393 | 0 | 81 | 15 | 0 | 0 | 96 |
| Sciences | 1,652 | 0 | 168 | 90 | 0 | 14 | 272 |
| Non-Degree | 143 | | | | | | |
| Total | 16,303 | | 2,025 | 728 | 8 | 72 | 2,833 |

Degrees awarded since 1896 (through August 1990) total 71,026 of which 426 have been associate degrees; 56,439 bachelor's degrees; 12,875 master's degrees; 160 education specialist degrees; and 1,126 doctorates. Includes 582 Clemson-Furman MBA degrees awarded May 1972-August 1990.

1990-91 Clemson Sports

| Sport | Home | Away | Neutral | ACC | Overall | Pct. | ACC Regular Finish | ACC Trn. | National Rank | 1st Team All-ACC | All American |
|------------------------|----------|-------|---------|---------|----------|------|--------------------------|-------------|------------------|---------------------|-----------------|
| Football | 6-0 | 3-2 | 1-0 | 5-2 | 10-2 | .833 | 2nd | — | 9th | 8 | 3 |
| Soccer | 13-3-2 | 3-0 | 0-1 | 4-1-1 | 16-4-1 | .786 | 1st | 5th | 4th | 2 | 2 |
| Women's Cross Country | — | — | — | — | — | — | — | 2nd | 3rd | 3 | 2 |
| Men's Cross Country | — | — | — | — | — | — | — | 4th | — | 0 | 0 |
| Volleyball | 12-3 | 3-7 | 8-4 | 2-4 | 23-14 | .622 | T-5th | 5th | — | 0 | 0 |
| Women's Basketball | 9-7 | 0-8 | 2-2 | 2-12 | 11-17 | .393 | 8th | 5th | — | 0 | 0 |
| Men's Basketball | 12-3 | 5-6 | 5-2 | 8-6 | 22-11 | .667 | 4th | 2nd | 8th | 0 | 0 |
| Wrestling | 5-0-1 | 3-2 | 2-0 | 5-0 | 10-2-1 | .808 | 1st | 4th | 15th | 2 | 2 |
| Women's Swimming | 3-2 | 2-0 | 1-0 | 4-1 | 6-2 | .750 | 2nd | 4th | — | 6 | 0 |
| Men's Swimming | 3-3 | 2-0 | 1-0 | 4-2 | 6-3 | .667 | 3rd | 4th | — | 1 | 0 |
| Women's Indoor Track | — | — | — | — | — | — | — | 2nd | 35th | 5 | 2 |
| *Men's Indoor Track | — | — | — | — | — | — | — | 1st | 44th | 7 | 2 |
| *Baseball | 31-1 | 18-6 | 11-3 | 18-3 | 60-10 | .857 | 1st | 1st | 4th | 5 | 3 |
| Women's Tennis | 10-4 | 4-4 | 1-3 | 6-1 | 15-10 | .577 | 2nd | 2nd | 25th | 3 | 0 |
| Men's Tennis | 5-3 | 6-6 | 3-5 | 6-1 | 14-14 | .500 | 2nd | 3rd | — | 3 | 0 |
| *Women's Outdoor Track | — | — | — | — | — | — | — | 1st | 12th | 6 | 6 |
| *Men's Outdoor Track | — | — | — | — | — | — | — | 1st | 13th | 9 | 4 |
| Golf | — | — | — | — | — | — | — | 5th | 13th | 2 | 1 |
| Overall Totals | 109-29-2 | 49-41 | 35-20 | 64-33-1 | 193-90-2 | .681 | 3 Firsts | 4 Firsts | 9 Top 15 | 62 | 27 |

*Indicates ACC Champion

UNIVERSITY RESEARCH

Clemson is ranked by the National Science Foundation among the top 100 educational institutions in total research and development expenditures.

During FY 90-91 the University received gifts, grants and contracts totaling in excess of \$39.7 million. This represents an average growth over the past six years of 26.8 percent per year. Total sponsored programs and unrestricted research expenditures exceeded \$85 million in FY 90-91.

Clemson provides unusual flexibility and opportunity for sponsors to leverage their research objectives by utilizing the vast array of the University's research organizations. The University's commitment to strengthen public and private research has historically built excellent internal and external partnerships to achieve research objectives. The institutional linkage of University research activities extends across the boundaries of academic colleges, institutes and centers to provide an effective foundation for collaboration and partnerships with government and industrial sectors.

The scholarship activities performed by faculty and administrators at the University significantly contribute to the environment and knowledge required to solve universal problems. During this past fiscal year, the Office of University Research processed more than 1,297 research proposals, grants and awards.

Of major importance, a five-year cooperative agreement between the Greenville Hospital System and Clemson was reached wherein the University's biologically oriented programs will be significantly enhanced. In turn, improved health care will be available to the area through the hospital system's access to the latest and most advanced educational and research programs in biomedicine. Mutually agreed upon areas of concentration include: health care delivery systems, bone and mineral metabolism, and reproductive physiology.

Of major significance to South Carolinians is an award from the Federal Emergency Management Agency (FEMA) to develop a comprehensive hazard mitigation program with emphasis on severe storm and earthquake damage. This five-year, \$1.7 million cost-sharing project will undertake the following tasks:

- Assess loads resulting from wind, waves and earthquakes;
- Evaluate resistance of enclosures;
- Establish stability of low-rise wood and masonry buildings;
- Develop improved codes, standards and inspection practices; and
- Prepare design guides, standards and conduct short courses.

Department of Research Services

The Department of Research Services is responsible for coordinating institutional compliance with federal laws regulating the use of animals in research, teaching and testing activities. This responsibility covers human subject research and compliance with NIH safety guidelines. In addition, the department provides technical and professional support to University personnel who use animals in research, teaching or testing activities. Notable accomplishments of Research Services during FY 90-91 include:

- All laboratory animal facility operations were centralized in January 1991. Computer record keeping systems have since been developed which meet federal compliance guidelines, while increasing the efficiency and accuracy of record keeping associated with animal care costs.
- Research Services received a \$195,980 grant from NIH to improve animal facilities. Renovation of animal facilities has been initiated.

- An Animal Care and Use Handbook and a training program were developed for research investigators and graduate students using animals in research, teaching and testing activities. The handbook is a comprehensive working document that will accommodate periodic updates to meet changing laws and regulations. Training programs were conducted for individual departments in 1991.
- Sponsorship was provided for a two-day workshop/meeting of the Southeast Branch of the American Association of Laboratory Animal Science. Participants were from the Medical University of South Carolina, University of South Carolina, University of Georgia and Clemson University.

Emerging Technology Center

The Emerging Technology Center (ETC) was established to assist inventors and entrepreneurs with the transfer and commercialization of emerging technology into innovative products and processes; to stimulate new high growth start-up companies; and to assist existing manufacturers to upgrade manufacturing operations in South Carolina. The center originated the state's only inventor conference and assisted in establishing the state's only major venture capital conference. The center has assisted more than 100 inventors, entrepreneurs and companies to commercialize innovative new products and processes.

The major accomplishment of the ETC during FY 90-91 was the establishment of the Clemson Center for Applied Technology (CAT). A 30,000-square-foot facility is being constructed and will be available for occupancy in October 1991. This facility is supported by grants from the Appalachian Regional Commission and the Savannah Valley Authority for approximately \$1.8 million. The CAT facility is unique in its functionality and organization for addressing the area of technology transfer and commercialization. The three major functions of the facility are:

- Incubate technology-based start up companies;
- Commercialize innovative consumer and industrial products and processes;
- Provide a comprehensive database and reference facility for individuals and organizations requiring assistance to commercialize, develop or implement innovative technology. All of the regional technology transfer representatives are located in the new facility to form an integrated, responsible network for technology.

To date, the ETC has been directly and indirectly responsible for finding more than \$11 million in private support for small expanding growth companies, more than \$1.5 million for private inventors who are commercializing their novel products, capturing more than \$300,000 in federal funds to support special technology transfer programs at Clemson, and attracting more than \$1.8 million to establish and construct the new unique Clemson Center for Applied Technology.

Clemson University Patent Committee

The Clemson University Patent Committee, after careful review, recommended revision of the Clemson University Patent Policy. This policy was approved by the Board of Trustees' Educational Policy Committee on June 20, 1991. The full Board voted on the revised policy on July 12, 1991.

The committee reviewed 17 patent disclosures during the year. The committee recommended that 12 be forwarded to a private patent attorney for patent application preparation and five to a patent/licensing firm for review for patentability and commercial potential. Five U.S. and three foreign patents were granted to Clemson during the year and two patented properties were licensed. The total patent income for the year exceeded \$1.2 million.

| | |
|--|-------------------|
| Total Number of Documents Printed | <u>255</u> |
| Cost Per Unit | \$ <u>5.72</u> |
| Printing Cost - S.C. State Budget & Control Board (up to 255 copies) | \$ <u>1458.89</u> |
| Printing Cost - Individual Agency (requesting over 255 copies) | \$ <u>—</u> |
| Total Printing Cost | \$ <u>1458.89</u> |

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